# CHAPTER 4

# 4. ENVIRONMENTAL CONSEQUENCES

This chapter describes the potential environmental consequences of the proposed alternatives for reducing $NO_X$ emissions at JSF with details organized by resource area. The potential impacts from the proposed action alternatives for reducing $NO_X$ emissions at JSF are categorized as construction impacts and operating impacts.

## 4.1 Air Resources

### *4.1.1 Alternative A – No Action*

Under the No Action Alternative, current air quality in the vicinity of JSF is expected to continue.

### *4.1.2 Construction Impacts of Action Alternatives*

Under the action alternatives, transient air pollutant emissions would occur during the construction phase of this project. Since the JSF site has already been developed as an industrial site, construction-related emissions would be relatively less than for a new site. Construction-related air quality impacts are primarily related to land clearing, site preparation, and the operation of internal combustion engines.

<u>Vehicle Emissions and Excavation Dust</u>

Land clearing, site preparation, and vehicular traffic over unpaved roads and construction sites result in the emission of fugitive dust particulate matter (PM) during site preparation and active construction periods. The largest size fraction (greater than 95 percent by weight) of fugitive dust emissions would be deposited within the construction site boundaries. The remaining fraction of PM would be subject to longer-range transport. If necessary, open construction areas and unpaved roads would be sprinkled with water to reduce fugitive dust emissions by as much as 50 percent.

Combustion of gasoline and diesel fuel by internal combustion engines (vehicles, generators, construction equipment, etc.) would generate local emissions of PM, $NO_X$, carbon monoxide, volatile organic compounds (VOCs), and sulfur dioxide throughout the site preparation and construction period. The total amount of these emissions would be small and would result in minimal off-site impacts.

Air quality impacts from construction activities would be temporary and dependent on both man-made factors (e.g., intensity of activity, control measures, etc.) and natural factors (e.g., wind speed, wind direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor, transient impact on off-site air quality that should not exceed or violate any applicable ambient air quality standard. Overall, the air quality impact of construction-related activities for the project would not be significant.

### *4.1.3 Plant Vicinity Operational Impacts From Action Alternatives*

Operation of the action alternatives for any of the options under consideration would not adversely impact local air quality. There would be the possibility, for all options except boiler optimization, of slight increases in ammonia concentrations downwind of the plant site. This possibility is discussed below. Overall, operation for the action alternatives would improve air quality.

<u>Ozone Scavenging Losses</u>

Ozone concentrations below background levels occur immediately downwind of $NO_X$ sources, such as power plants, due to ozone scavenging, i.e., NO emissions consuming ozone. Significant ozone production does not occur until 20 to 80 kilometers (12.4 to 49.7 miles) downwind of the $NO_X$ source. The reduction of $NO_X$ emissions may reduce the size of the area in which ozone scavenging occurs. While ozone concentrations may increase slightly in areas previously affected by ozone scavenging, they are not expected to increase above background ozone levels.

<u>Plume Opacity and Plume Blight</u>

Plume opacity is determined by the amount of $NO_2$ and PM emitted. Due to the optical properties of $NO_2$, it tends to give a plume a slight reddish-brown color when viewed against a clear sky. Since the action alternatives would greatly reduce $NO_X$ emissions, they would also be expected to reduce plume opacity. There is a possibility that SCR operation would be accompanied by an increase in sulfur trioxide ($SO_3$) emissions, which could result in some offset of the plume visibility improvements due to $NO_X$ reduction. The potential exists, however, for minor increases in plume visibility under some meteorological and operational conditions.

### *4.1.4 Regional Operational Impacts From Action Alternatives*

<u>Introduction</u>

The primary purpose of the action alternatives is to reduce emissions of $NO_X$, a pollutant that can, in combination with VOCs and sunlight, lead to the production of ozone. The purpose of this section is to describe the nature of ozone and the impacts that reducing $NO_X$ emissions from JSF would have on ambient ozone levels. In addition, the potential impact of the action alternatives on secondary particulate formation and regional haze is described.

<u>Ozone</u>

Ozone forms in the atmosphere as a result of a mixture of $NO_X$ and VOCs being exposed to sunlight. Both $NO_X$ and VOCs have natural and anthropogenic (man-made) emissions sources. For example, isoprene (a VOC important in ozone formation) is primarily emitted from trees and crops. Other VOCs, however, are emitted into the atmosphere as the consequence of human activity, such as the use of solvents or the operation of motor vehicles. While there are also natural sources of $NO_X$, they are relatively small compared to the $NO_X$ emitted from motor vehicles and other forms of fuel combustion. Since large utility boilers burn large quantities of fossil fuel, they are a major source of the $NO_X$ emitted into the atmosphere.

Ozone levels in the TVA region have historically been less than the NAAQS (with the exception of a few urban centers). With the recent revision of the ozone standard from a 1-hour average concentration of 120 parts per billion to an 8-hour average concentration of 80 parts per billion, more areas in the TVA region are expected to experience ozone concentrations exceeding the standard. Furthermore, it is anticipated that a number of urban areas—even some remote, rural areas in the Appalachian Mountains—which barely met the former 1-hour standard will experience ozone concentrations above the 8-hour standard.

Although it is not possible to quantify the change in ambient ozone concentration (or the frequency of that change) at a specific place due to $NO_X$ emission reductions at JSF, it is known from previous modeling and air quality research that the overall effect would be to reduce the amount of ozone produced in the atmosphere. It is also known that the area that would benefit the most would be the area within about 150 kilometers (93.2 miles) downwind from JSF.

Secondary Particulate and $PM_{10}$/$PM_{2.5}$

Except for the boiler optimization option, all other options under the action alternatives require the use of ammonia or urea. In the SNCR $NO_X$ reduction process, the urea decomposes to ammonia and carbon dioxide. The ammonia in turn reacts with $NO_X$. Although almost all of the ammonia or urea is chemically converted to nitrogen and water in the reactions that are responsible for the reduction in $NO_X$ emissions, there is a possibility that some ammonia would be emitted from the stack. Since ammonia is associated with the formation of particulate in the atmosphere, any ammonia that is emitted has the potential to result in the formation of additional atmospheric particulate. Therefore, allowing ammonia to slip through the system without reacting can lead to the formation of particulate leading to a slight increase in the atmospheric particulate burden. The potential for an increase in particulate due to ammonia emissions could possibly be more than offset by the decrease in particulate due to $NO_X$ reductions ($NO_X$ is a source of secondary particulate). With the eastern bituminous coal presently being burned at JSF, the $SO_3$, which would be produced during the combustion process, would be expected to react with and remove unreacted ammonia for slip rates of about 5 parts per million by volume (ppmv) for all four units. Since the four units at JSF share two stacks, if one unit sharing a common stack operated at 10-ppmv ammonia slip while the second unit on that stack had zero ammonia slip (for SCR operation; SNCR cannot operate with zero ammonia slip), the $SO_3$ from the second unit could be expected to react with and remove the excess ammonia from the first unit.

There is limited experience and knowledge about the operation of SNCR on large utility boilers and the variables that impact the $NO_X$ reduction efficiency and the formation of other compounds from reactions of other flue gas constituents with the unreacted ammonia in the flue gas path. There is conflicting information concerning the formation of ammonium sulfate and ammonium bisulfate and the factors affecting the reaction products, the affinity of fly ash for ammonia and the factors affecting the revolatilization of ammonia that can release it back into the flue gas stream. To better assess how excess unreacted ammonia reacts with other flue gas constituents and the fate of those reaction products, a flue gas sampling and monitoring program will be implemented during the study phase of the project. The monitoring and sampling program is described in Appendix C and is similar to other monitoring and sampling programs conducted by TVA in studies on SNCR $NO_X$ control technologies at other locations.

### *4.1.5 Ammonia Handling and Storage Safety*

Alternative A: No Action

Under the No Action Alternative, no new substances hitherto not used on the JSF site would be introduced, so no new risks would be introduced to the plant site and the surrounding communities. However, no benefits to public health that may result from improvements to local and regional air quality would be achieved.

Alternative B: Boiler Optimization

Under Alternative B, Boiler Optimization, some improvements to local and regional air quality may be achieved. These improvements may result in some limited benefits to public health. Under Alternative B, no new potentially hazardous substances would be introduced at the JSF site, so no adverse impacts to safety and health would be anticipated.

Action Alternatives C, D, E, and F:
Anhydrous Ammonia Storage and Handling Safety

Action Alternative C, SNCR, could be installed and operated using urea solutions or aqueous ammonia solutions instead of anhydrous ammonia, but since it is possible to operate an SNCR system with ammonia, and TVA may elect to operate in this manner at some point in the future, for the purposes of this EA, Alternative C may be assumed to potentially involve use of anhydrous ammonia. Alternatives D and E would use anhydrous ammonia. Alternative F would use anhydrous ammonia if SNCR using anhydrous ammonia or SCR were selected.

Background on Anhydrous Ammonia

Anhydrous ammonia is 99.5 percent commercial grade ammonia (with 0.5 percent water) as compared to aqueous ammonia, which is a solution of ammonia and water. A saturated aqueous ammonia solution is 47 percent ammonia by weight at 32°F and at atmospheric pressure (by comparison, household ammonia is a 5 percent solution). Anhydrous ammonia is very volatile and boils at –33.5°C under atmospheric pressure. Anhydrous ammonia must be pressurized or refrigerated to be maintained as a liquid. Air mixtures of ammonia are difficult to ignite. The auto ignition temperature is 650°C. The lower explosive level is 16 percent by volume, and the upper explosive level is 27 percent by volume. The reportable quantity under the Comprehensive Environmental Responsibility, Compensation, and Liability Act for release of ammonia is 100 pounds.

Excerpts from a typical material safety data sheet (MSDS) for ammonia concerning the acute and chronic health hazards are as follows:

> *Inhalation: Vapor may cause irritation to the respiratory tract. High atmospheric concentrations in excess of the occupational exposure limit may cause injury to the mucous membranes. Fluid buildup on the lung (pulmonary edema) may occur up to 48 hours after exposure to extremely high levels and could prove fatal. The onset of the respiratory symptoms may be delayed for several hours after exposure.*
>
> *Skin Contact: High concentrations of vapor may cause irritation. By rapid evaporation, the liquid may cause frostbite.*
>
> *Eye Contact: The vapor is an irritant, but the liquid is a severe irritant. Liquid splashes or spray may cause freeze burns. May cause severe damage if eye is not immediately irrigated. The full effect may occur after several days.*
>
> *Ingestion: Will cause corrosion of and damage to the gastrointestinal tract.*

*Long-term Exposure: This material has been in use for many years with no evidence of adverse effects.*

Air concentration thresholds have been established for ammonia as guides for purposes of monitoring short-term and long-term occupational exposure, and for the purpose of emergency planning. These threshold concentration values for ammonia vapor, their application, and the reference guideline, standard, or regulation are listed in Table 4-1.

The toxic endpoint concentration for ammonia, based on Emergency Response Planning Guideline 2 is 197 parts per million (ppm) (140 mg/m$^3$ [milligrams per cubic meter] or 0.14 mg/L). It was developed by the American Industrial Hygiene Association and defined as the maximum airborne concentration below which nearly all individuals can be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.

**Table 4-1. Ammonia Concentration Limits in Air**

| Concentration | Application | Reference |
|---|---|---|
| 25 ppm (17.75 mg/m$^3$) | Recommended exposure limit for 10-hour workday during a 40-hour work week | NIOSH Guide and ACGIH |
| 35 ppm (24.85 mg/m$^3$) | Short-term exposure limit not to be exceeded in a 15-minute period | NIOSH Guide and ACGIH |
| 50 ppm (35.5 mg/m$^3$) | Permissible exposure limit | OSHA |
| 197 ppm (140 mg/m$^3$) | The concentration that defines the endpoint for a hazard assessment of off-site consequences | 40 CFR 68 |
| 500 ppm (355 mg/m$^3$) | Concentration that is immediately dangerous to life or health for a worker without a respirator with an exposure time greater than 30 minutes | NIOSH Guide and ACGIH |

ppm = parts per million
mg/m3 = Milligrams per cubic meter
NIOSH = National Institute for Occupational Safety and Health
ACGIH = American Conference of Governmental Industrial Hygienists
OSHA = Occupational Safety and Health Administration
CFR = Code of Federal Regulations

Anhydrous Ammonia Safety

The storage and handling of anhydrous ammonia in large quantities is a potentially significant hazard. This requires attention to the engineered features, control and mitigation safeguards, and operating procedures and training for plant personnel. Applicable guidelines, standards, and regulations related to the use of anhydrous ammonia are listed below.

- American National Standard Institute Standard K61.1 (CGA Standard G-2.1)— Storage and Handling of Anhydrous Ammonia
- 29 CFR 1910.38 — Employee Emergency Plans and Fire Protection Plans
- 29 CFR 1910.111 — Storage and Handling of Anhydrous Ammonia
- 29 CFR 1910.119 — Process Safety Management of Highly Hazardous Chemicals

- 29 CFR 1910.1000 — Air Contaminants
- 40 CFR 68 — Chemical Accident Prevention Provisions
- Pocket Guide to Chemical Hazards — National Institute for Occupational Safety and Health (NIOSH)
- Threshold Limit Values for Chemical Substances — American Conference of Governmental Industrial Hygienists (ACGIH)
- Emergency Response Guidebook — U.S. Department of Transportation

The applicability of standards and regulations are generally triggered by the quantity of ammonia stored. These quantities are called threshold quantities and are listed in Table 4-2.

**Table 4-2. Regulatory Threshold Quantities for Ammonia**

| Chemical | Threshold Quantity (pounds) | Federal Regulation |
|---|---|---|
| Anhydrous Ammonia | 10,000 | 40 CFR 68 |
| Aqueous Ammonia >20% | 10,000 | 40 CFR 68 |
| Anhydrous Ammonia | 10,000 | 29 CFR 1910.119 |
| Aqueous Ammonia >44% | 15,000 | 29 CFR 1910.119 |

> = greater than
% = percent

The proposed minimum storage quantity for the JSF SCR systems (60,000 gallons or 289,883 pounds) would exceed threshold quantities. In addition to on-site storage, anhydrous ammonia must be transported to the plant site to replenish system storage. The use of railcars with a capacity of 33,000 gallons (159,390 pounds) would be the mode of transportation.

Risk Factors

The risk and potential severity of an ammonia storage or handling accident would be influenced by a number of factors including:

- Design of the ammonia storage and handling facility including engineered features and safeguards, and the quantity of ammonia stored.
- Railcar transportation for ammonia deliveries and the frequency of deliveries (see Section 4.11).
- Procedures for normal operations.
- Training of operations personnel for normal operations and emergency response.
- Population distribution in the plant vicinity.
- Emergency planning and response procedures.

- Probability of events, such as earthquakes and tornadoes, that could initiate a worst-case release.

Engineered Features and Safeguards

Properly engineered features and safeguards as well as adequate operating and maintenance procedures and training should make accidents unlikely and limit their consequences. Adherence to standards such as CGA G-2.1 or OSHA 29 CFR 1910.111 can result in safe equipment design. Compliance with 40 CFR 68 and 29 CFR 1910.119 ensures proper hazard assessment, operating procedures, employee training, and emergency planning have been provided.

A primary feature for limiting the potential hazard from an ammonia leak would be a water deluge (fogging) system with both automatic and manual actuation to address both the storage tank area and unloading area. A deluge system applies a fog blanket of small water droplets to wash ammonia vapor from the air, combining with the ammonia to form liquid aqueous ammonia, which would drain to the ammonia storage area emergency spill retention pond and then to the ash pond. As discussed in the Groundwater Resources Section (4.3) below, preliminary site evaluations indicate that the emergency spill retention pond would at a minimum be lined with clay or compacted in-situ soil. The ammonia-water mixture resulting from an emergency release would be sampled, analyzed, and managed in a way that prevented significant impacts. This would prevent uncontrolled discharge of aqueous ammonia to surface waters, which would kill aquatic life.

To be effective, a deluge system must, at a minimum, deliver a uniform spray of fine droplets over the surface of an ammonia spill at a rate that exceeds the mass transfer (boil-off) of anhydrous ammonia by a factor of at least 3.5. This accounts for the fact that a saturated aqueous ammonia solution at 100°F (summer design condition) is about 29 percent ammonia by weight. Thus, 3.5 pounds of water must be combined with each pound of ammonia vapor boiling off of a spill simply to achieve a saturated solution. The deluge system would limit the impact of an ammonia leak but may not entirely mitigate the impact on surface water of the worst-case failure of a storage tank or other catastrophic release. Because of the low probability of a worst-case failure, this impact is not considered significant.

### *4.1.6 Propane Storage and Handling Safety (Action Alternatives D and F)*

Background Information on Propane

Propane is a liquefied petroleum gas and aromatic hydrocarbon that may be utilized as a gaseous fuel. Propane is a colorless gas. For safety and detection purposes, a chemical odorant (ethyl mercaptan) is added to propane. The presence of the odorant alerts one of a potential propane gas leak. Other hydrocarbons used for fuel include methane (natural gas) and butane (disposable cigarette lighters). Unlike methane vapor that is lighter than air, propane vapor is heavier than air. Unlike liquid butane that will not vaporize at temperatures less than 0°C, liquid propane will vaporize at any temperature above -42°C. A gallon of liquid propane weighs 4.24 pounds and contains 91,650 British thermal units. The auto ignition temperature is 467°C. Propane has a narrow range of flammability when compared to other petroleum products. In order to ignite, the propane/air mix must contain from 2.2 to 9.6 percent propane vapor. Propane and all other hydrocarbon-based fuels must be kept away from open flames and ignition sources. Propane must also be handled with care, transported properly, and stored safely.

Excerpts from a typical MSDS for propane concerning the acute and chronic health hazards are as follows:

> *Inhalation: Oxygen deficient atmospheres may produce rapid breathing, headache, dizziness, visual disturbances, muscular weakness, tremors, narcosis, unconsciousness, and death, depending on concentration and duration of exposure.*
>
> *Eye Contact: This gas is non-irritating, but direct contact with liquefied/pressurized gas or frost particles may produce severe and possibly permanent eye damage from freeze burn.*
>
> *Skin Absorption: This material is not expected to be absorbed through the skin.*
>
> *Skin Irritation: Non-irritating, but solid and liquid forms of this material and pressurized gas can cause freeze burn.*
>
> *Ingestion: Solid and liquid forms of this material and the pressurized gas can cause freeze burn.*

The NIOSH/OSHA recommended exposure limit for propane is 1000 ppm (1800 mg/$m^3$). This is a time-weighted average concentration for up to a 10-hour workday during a 40-hour workweek. The immediately dangerous to life or health concentration is 2,100 ppm.

Propane Safety

The storage and handling of propane in large quantities is a potentially significant hazard. This requires attention to the engineered features, control and mitigation safeguards, and operating procedures and training for plant personnel. Applicable guidelines, standards, and regulations related to the use of propane are listed below:

- 29 CFR 1910.38 — Employee Emergency Plans and Fire Protection Plans
- 29 CFR 1910.110 — Storage and Handling of Liquefied Petroleum Gases
- 29 CFR 1910.119 — Process Safety Management of Highly Hazardous Chemicals
- 29 CFR 1910.1000 — Air Contaminants
- 40 CFR 68 — Chemical Accident Prevention Provisions
- Pocket Guide to Chemical Hazards — National Institute for Occupational Safety and Health (NIOSH)
- Threshold Limit Values for Chemical Substances — American Conference of Governmental Industrial Hygienists (ACGIH)
- Emergency Response Guidebook — U.S. Department of Transportation

The applicability of standards and regulations are generally triggered by the quantity of propane stored. These quantities are called threshold quantities, and the threshold quantity for propane is 10,000 pounds (40 CFR 68).

The proposed minimum storage quantity for JSF (180,000 gallons or 763,200 pounds) would exceed threshold quantities. In addition to on-site storage, propane must be transported to the plant site to replenish system storage. The use of railcars with a capacity of 33,000 gallons (139,920 pounds) would be the mode of transportation.

Risk Factors

The risk and potential severity of a propane storage or handling accident would be influenced by a number of factors including:

- Design of the propane storage and handling facility including engineered features and safeguards, and the quantity of propane stored.
- Railcar transportation for propane deliveries and the frequency of deliveries.
- Procedures for normal operations.
- Training of operations personnel for normal operations and emergency response.
- Population distribution in the plant vicinity.
- Emergency planning and response procedures.
- Probabilities of events, such as earthquakes and tornadoes, that could initiate a worst-case release.

Engineered Features and Safeguards

Properly engineered features and safeguards as well as adequate operating and maintenance procedures and training should make accidents unlikely and limit their consequences. Adherence to standards such as OSHA 29 CFR 1910.110 can result in safe equipment design. Compliance with 40 CFR 68 and 29 CFR 1910.119 ensures proper hazard assessment, operating procedures, employee training, and emergency planning have been provided.

Propane facilities must be protected against tampering with systems and appurtenances and from accidental collision of vehicles with containers and/or transfer lines. Requirements to prevent such tampering or accidents are specified in the code. The propane facility should have proper lighting, vehicle impact protection, corrosion protection, a perimeter fence, personnel training, and lock-in-place devices to prevent unauthorized use or operation.

The potential for ignition of vapors of propane released in a facility is reduced by eliminating as many ignition sources as possible, designing electrical equipment to reduce or eliminate sparking, and ensuring that during transfer operations known ignition sources are turned off. The ignition source control involves both passive methods as well as active methods. Examples include: Weeds and tall grasses should not be closer than 10 feet from each storage tank; approved, portable, dry chemical fire extinguishers should be provided at the facility; and the prohibition on smoking within the facility premises should be strictly enforced.

The separation distance provisions in National Fire Protection Association 58 are minimum requirements and are intended to buy time in an emergency and to implement appropriate response. The requirements are dependent upon the size of the storage tank. The minimum separation distance from an aboveground 30,000-gallon propane storage tank to buildings and property line is 75 feet.

Adherence to the noted guidelines, standards, and regulations, as well as implementation of the engineered features and safeguards, would additionally reduce the potential for impacts to occur from an accidental release.

## 4.2 Surface Water Resources

The potential impacts to surface water from the proposed action alternatives for reducing $NO_X$ emissions at JSF can be categorized as construction impacts, operating impacts, or those occurring from nonroutine (emergency) situations. Because of the complexity of the possible wastewater pathways for ammonia to result in impacts, the sections are structured such that there is discussion, where appropriate, of possible pathways and sources of impacts, cause and effect relationships and mitigation identified as needed to ensure insignificance of impacts to surface waters from that particular pathway.

### *4.2.1 Construction and Operational Impacts for Alternative A – No Action and Alternative B – Boiler Optimization*

There would be no impacts to surface water resources for the No Action Alternative. For Alternative B, Boiler Optimization, all modifications would take place within the existing powerhouse, and there would be no foreseeable impacts to surface water for either construction or operation.

### *4.2.2 Construction and Operational Impacts for Alternative D*

<u>Construction Impacts</u>

Construction activities for this action alternative involve disturbance of 20 acres or less. Most of the construction activity would occur in the vicinity of the existing powerhouse, with some construction on the east side of the plant for ammonia tanks, ammonia spill retention pond, and propane tanks. All construction activities would be within the existing plant site. Surface runoff that flows to the ash pond is currently permitted. Construction-related runoff may require a storm water construction permit if more than an acre is disturbed. Using appropriate BMPs, all construction activities would be conducted to ensure that waste materials are contained and that no polluting materials are introduced into receiving waters and potential impacts are insignificant.

Portable toilets would be provided for the construction workforce. These toilets would be regularly pumped out and the sewage transported by tanker truck to a publicly owned treatment works accepting pump out.

<u>Operational Impacts</u>

Normal operation of a low-dust SCR (Alternative D) would not be expected to result in the deposition of ammonia compounds in the APHs or on fly ash. The only potential for ammonia entering the wastewater stream would be from the accidental release of ammonia from the storage tanks, line leaks, or rupture, and as accumulated from the ammonia blowdown line. The potential for accidental release is discussed in Section 4.1.6 and is considered quite low and insignificant. The amounts of ammonia potentially entering the wastewater streams at JSF from the blowdown line is small and negligible in terms of potential for producing significant environmental effects to surface waters.

### 4.2.3 Construction and Operational Impacts From Alternatives C, E, and F

Construction Impacts

Construction impacts under these alternatives would be the same as under Alternative D, except that Alternatives C, E, and F may involve construction of a diffuser (discussed later in this section) on one or more of the wastewater discharge points and rerouting storm water and wastewater flows to one or both of the MCTPs, the ash pond, or the CCW discharge channel within the areas previously disturbed by plant construction. The construction of the diffuser would require an ARAP from the State of Tennessee. Alternative C could also involve construction of urea solution storage tanks, urea dissolution tanks, or solid urea storage warehouses.

Operational Impacts

Operation of SNCR, and high-dust SCR would be expected to result in deposition of unreacted (slipped) ammonia compounds in the APHs and on the fly ash being discharged to the wet and dry ash handling systems through the precipitators. Regardless of which of the three alternatives (C, E, or F) were implemented, this deposition in turn would likely result in ammonia compounds entering various components of the wastewater treatment stream from four sources, i.e., (1) when the APHs are washed, (2) when fly ash is wet sluiced to the ash pond, (3) when rainfall dissolves ammonia compounds off of exposed ammonia-contaminated fly ash on the active ash handling area of the dry fly ash landfill, and (4) for the SCR options, as condensate from the ammonia blowdown line (Alternative E). Since the water quality criteria for ammonium compounds are written in terms of ammonia nitrogen, the term ammonia nitrogen, represented by the chemical symbol, $NH_3$-N, will be used to refer to all of the different ammonia-based compounds that might potentially be formed by the reaction of excess unreacted ammonia with other compounds present in flue gases and be subsequently deposited on the fly ash, the APHs, or in the wastewater.

If not properly controlled, the anticipated amounts and concentrations of ammonia nitrogen depositing on fly ash for any of the three alternatives could potentially produce significant impacts to off-site water resources. Also, with the exception of ammonia condensate in blowdown, the above-identified sources of $NH_3$-N individually each have the potential to produce significant impacts to surface waters if not controlled and mitigated. These four potential sources, amounts of $NH_3$-N anticipated to result from each source, their potential total effect, and mitigation measures are summarized below and discussed in detail in Appendix A. Ensuring that impacts to off-site surface waters and water resources are insignificant, and that JSF meets existing permit requirements, would involve control of the ammonia-nitrogen compounds through a suite of actions (e.g., use of existing wastewater treatment systems, design features of the proposal, commitment to operational controls and mitigations are all important aspects). As identified for the various sources and alternatives (Section 2.5 Summary of Commitments), some of these actions would be clearly required under all scenarios, while a firm need for others is contingent upon the actual soluble ammonia nitrogen on ash content and $NH_3$-N leachate concentrations that result and other data to be gained during operational monitoring of the $NO_X$ reduction system(s) chosen (see below).

Selection of environmentally protective and cost-effective methods for controlling ammonia nitrogen is complicated by the fact that available information indicates a wide range for amounts of possible ammonia deposition on fly ash from the $NO_X$ reduction systems under consideration. Published studies indicate considerable variations, and therefore some degree of uncertainty, in likely ammonia compound accumulation on fly ash depending on the ammonia slip rates, the type of coal burned, operating conditions, site-specific equipment configuration, and the particle sizes of the fly ash (Electric Power Research Institute [EPRI], 1998; 2004).

Concentrations of ammonia on ash likely to result are, therefore: (1) somewhat uncertain and cannot be absolutely determined until at least test phases of the $NO_X$ reduction systems are operational; (2) but based upon the available studies and information the range can be bounded (see below) for the present analyses of impacts and identification of effective mitigations; and (3) in an adaptive approach for controlling ammonia nitrogen, among the mitigations identified in this EA, the specific array of mitigations implemented would be selected based upon timely evaluation of operational monitoring data as laid out in the monitoring, sampling, and mitigative action plan as discussed in section 2.5 Summary of Environmental Commitments and Appendices A and C.

Based upon these reports and operational information from TVA facilities operating $NO_X$ reduction equipment, for the purposes of evaluating potential environmental impacts, ammonia concentrations on fly ash ranging from 12.5 to 500 mg/kg were used, as appropriate, in various technical analyses for this EA (Appendix A). This range of ammonia concentrations on fly ash was also used as the basis and bounds for evaluating impacts and identifying mitigation measures appropriate for predicted ammonia compound accumulations on fly ash, such that surface water resources would be protected. Additionally, through the proposed approach of adaptive monitoring, evaluation, and decision-making, over time, TVA will continue to gain more knowledge about the plant-specific operational characteristics of $NO_X$ reduction technology at JSF, continue to evaluate the performance characteristics of alternatives, and adapt decisions on technology installations and options for mitigating ammonia concentrations consistent with their potential for impacts confirmed with monitoring data.

In addition to a summary of overall mitigation strategy at the end of this section, a short discussion of each of the four areas is provided because of: (1) the multiple pathways for ammonia nitrogen to enter the wastewater streams at JSF and eventually to reach surface waters (i.e., Polly Branch and the Holston River); (2) the potential for each source (except blowdown), if unmitigated, to cause significant impacts to surface waters; and (3) the need to identify source-specific mitigations.

*Ammonia Accumulation in Air Preheaters (APHs) and Resulting Concentrations in APH Wash Water*

The varying ammonia slip rates, which could result in 12.5 to 500 mg/kg concentrations of $NH_3$-N on fly ash, could result in accumulation of sufficient mass of ammonium compounds in the APHs subsequently to yield high concentrations of $NH_3$-N in APH wash water. The APHs for each unit are presently washed once every two to three years; accumulations of ammonium compounds in the APHs could possibly require washing more frequently. Presently APH wash water is routed directly to the ash pond. Estimates indicate the annual amount of ammonia nitrogen that could accumulate in the two APHs per unit would be between about 1,200 and 6,400 pounds. Even at the lowest probable accumulation of ammonium compounds in the APH for a one-unit test (i.e., 1,200 pounds $NH_3$-N) without mitigation, the predicted resulting concentrations of ammonia nitrogen in the ash pond would likely result in intermittent failure of the ash pond discharges to meet USEPA Water Quality Criteria for Ammonia (USEPA 1999) in Polly Branch, the receiving stream for ash pond discharges. , This situation requires that a strategy for mitigating potential surface water impacts from APH washes be in place prior to even a one-unit test or operation of SNCR or high-dust SCR. With implementation of any one of the six mitigation strategies for managing APH washes described below and in greater detail in Appendix A, the concentrations of ammonia in discharges would be reduced to the point where effects to surface water quality or aquatic ecology would be insignificant. The six effective mitigation options, per an operational plan to be developed with selection of an option, are:

(1) Capturing APH wash water into the MCTP, then slowly releasing ammonia-contaminated APH wash water from the MCTP to the ash pond per an operational plan to maintain ash pond discharges within the USEPA Water Quality Criteria for Ammonia.

(2) Mitigation Option #1 with pH control on the ash pond effluent.

(3) APH wash water mitigation by capturing and treating the assumed, more highly contaminated first flush plus slowly releasing the less-concentrated APH wash water to the ash pond.

(4) Capturing the APH wash water in the MCTP then staged pumping of the MCTP to the CCW.

(5) Capturing the APH wash water in the MCTP then pH adjustment and air stripping ammonia followed by staged release to the ash pond or the CCW.

(6) Designing, installing, and operating equipment at the MCTP to facilitate reduction of ammonia concentrations by nitrification followed by staged release to the ash pond or CCW. This would mitigate ammonia contamination in APH wash water such that expected NPDES permit requirements would be met, aquatic life criteria for ammonia would not be exceeded, and environmental impacts would be insignificant.

APH wash water mitigation Options 1 and 3 may not require pH control on the ash pond effluent if the APH ammonia loadings are at the low end of the range in Appendix A, Table A-1. However, even relatively low ammonia nitrogen concentrations in the ash pond might promote algal growth during warm weather. This potential algal growth could remove dissolved carbon dioxide from the water resulting in greatly increased pH. For this reason, installation of pH control on the ash pond effluent would ensure compliance with anticipated NPDES limits. If Action Alternative C, E, or F were selected, TVA would either select one of these six alternative mitigations for APH wash water, or in the event that another equally effective method should be identified for implementation, conduct the appropriate environmental review on the new mitigation option(s) at that time.

<u>Wet Sluicing of Fly Ash During Startup, Shutdown, or Upset Condition</u>

Although most of the fly ash at JSF is now handled dry, the plant retains the ability to wet sluice the fly ash to the bottom ash pond. Wet sluicing still occurs at the plant during unit startup, shutdown, or when the dry handling system is experiencing an upset. Wet sluicing occurs 12-32 times per year and could contribute a substantial “spike” amount of additional ammonia-nitrogen loading to the ash pond for higher concentrations of soluble $NH_3$-N on the fly ash.

The total estimated annual tonnage of fly ash that may be wet sluiced to the ash pond would be 278 to 742 tons. Only fly ash resulting from wet sluicing during a unit shutdown following operation of the $NO_X$ reduction equipment would potentially be contaminated with $NH_3$-N. Since the $NO_X$ reduction equipment is not operated until the unit stabilizes, fly ash sluicing following unsuccessful unit starts would not be expected to increase $NH_3$-N loadings on the ash pond. Mixing with the 50 to 500 mg/kg $NH_3$-N fly ash would be the average ash pond flow of 2.6 million gallon water flow per 8-hour shift.

The concentrations of ammonia in DSN 001 that could result from fly ash sluicing (assuming no biodegradation of ammonia compounds occurs in the ash pond) are shown in Table 4-3. As shown, ammonia loadings on the fly ash up to approximately 150 mg/kg could be discharged to the bottom ash pond without exceeding an $NH_3$-N concentration of 0.29 mg/L, which for Polly Branch (Table 3-5) represents a concentration protective of aquatic life as specified by the USEPA Water Quality Criteria for ammonia under conditions of continuous discharge during periods of high temperature and pH occurring at JSF. The proposed one-unit test of SNCR would be expected to operate at 50 mg/kg $NH_3$-N on ash, so the anticipated resulting $NH_3$-N concentrations in the ash pond resulting from wet sluicing one unit would be well below the protective limit concentration of 0.29 mg/L $NH_3$-N. Thus, limiting $NH_3$-N accumulations on fly ash by limiting ammonia or urea injection in the SNCR units per an operational plan should suffice as a control measure during the one-unit test phase. However, as a precautionary measure, a pH control system would be installed on the ash pond to maintain the pH of Outfall DSN001 within anticipated NPDES limits. At pHs below 7.8, even the maximum ammonia-nitrogen concentration of 500 mg/kg would not result in an aquatic toxicity issue. The values in Table 4-3 are based on single-unit emergency shutdown. Limiting injection of urea or ammonia following an unplanned shutdown would greatly reduce the risk of overloading the ash pond with $NH_3$-N in the event of an unplanned shutdown of another unit. For planned shutdowns, an additional procedure would be to turn the ammonia or urea injection off at least 8 hours before unit shutdown. This would mean that the fly ash in the hoppers that might be wet sluiced would be at least 80 percent free of ammonia. TVA would select among a combination of these measures to manage and further reduce the potential impacts of wet sluicing fly ash containing ammonia at JSF. If improvements to the dry fly ash handling system at JSF decrease the amounts of fly ash potentially subject to being wet sluiced, the operational plan would be amended as appropriate to maintain compliance with anticipated NPDES $NH_3$-N limits.

**Table 4-3. Potential Ash Pond $NH_3$ Concentrations from Startup, Shutdown, or Upset Wet Sluicing**

| Estimated Soluble Fly Ash Ammonia Content (mg/kg $NH_3$) | 50 | 62.5 | 100 | 150 | 200 | 250 | 300 | 400 | 500 |
|---|---|---|---|---|---|---|---|---|---|
| Fly ash wet sluiced, pounds of $NH_3$-N (23.2 tons/event) | 1.91 | 2.39 | 3.82 | 5.73 | 7.64 | 9.55 | 11.5 | 15.3 | 19.1 |
| Fly ash wet sluiced, ash pond (Outfall 001) effluent $NH_3$-N (23.2 tons/event) | 0.09 | 0.11 | 0.18 | 0.26 | 0.35 | 0.44 | 0.53 | 0.70 | 0.88 |

<u>Management of Ammonia Compound Loadings to Wastewater Treatment System From Storm Water Leaching of the Dry Fly Ash Storage Area</u>

During a rainfall event sufficient to yield runoff from the dry fly ash stacking (storage) area, a portion of the ammonia compounds accumulated on the dry fly ash would leach and enter the wastewater stream with the runoff. Storm water runoff from the dry fly ash stack flows into a sediment pond, traverses a half-mile-long drainage ditch where Wetland JSFW01 has formed, and then enters the DSS pond. Currently, this pond does not overflow except during heavy or extended rain periods. Operating $NO_X$ emissions reduction equipment would not change this situation; most storm water runoff would simply remain in the pond evaporating, and due to the long residence times in the DSS pond, biodegradation of ammonia would be highly probable. On infrequent occasions, the pond does overflow through Outfall F-16A. This outfall discharges to Polly Branch and ultimately to the Holston River. Because of the intermittent nature of discharges from Outfall F-16A, the most applicable ammonia-nitrogen criterion deemed protective of aquatic life (Table 3-5) is 0.72 mg/L, or 2.5 times the CCC (see Section 3.2.2).

To evaluate the potential for operation of SNCR or high-dust SCR to impact surface waters by causing ammonia contaminated storm water runoff from the dry fly ash stack, daily runoff was computed using the USEPA HELP model for a relatively wet five-year period (actual rainfall events equivalent to the actual rainfall that fell from 1993 to 1997). Transfer of ammonia from exposed ash to surface runoff was modeled using the physically based soil diffusion and runoff transport model of Wallach et al. (1988). It was assumed that the exposed surface area of the stack had just reached maximum capacity before being covered. As discussed earlier, the estimated concentrations of ammonia on the fly ash used for the model ranged from 12.5 to 500 mg of ammonia nitrogen per kg of fly ash. Modeling assumed a maximum active ash handling area of 10 acres. Restricting the amount of dry fly ash exposed to 10 acres or less is an important factor in limiting the amount of ammonia contaminated ash available to be leached by rainfall, i.e., the greater the surface area of exposed dry fly ash, the more ammonia that would be available to be dissolved by rain during a rain event.

Modeling results and analyses indicate that for a one-unit test of SNCR technology with the anticipated no more than 50 mg/kg $NH_3$-N on ash (12.5 mg/kg when averaged with ash from the other three units), predicted maximum concentrations of $NH_3$-N in runoff discharges (i.e., 0.6 mg/L) that do intermittently occur from Outfall F-16A would be under the applicable water quality criterion for ammonia that is deemed protective of aquatic life (i.e., 0.72 mg/L). Predicted impacts of the one-unit test to surface waters and aquatic life would, therefore, be insignificant. If the average soluble $NH_3$-N on ash concentration for all four units of SNCR or SCR technology were to be maintained at or below the 12.5 mg/kg level, impacts from installation of SNCRs or high-dust SCR on all four units would also be insignificant. However, as this concentration of ammonia on ash would correlate to a low ammonia slip rate or indicate the ammonia slip was being discharged along another pathway to either the water or air, this latter situation would be highly unlikely for four-unit installation, and as discussed below, mitigation(s) would be necessary.

As part of monitoring for the test and potential full installations, TVA would monitor parameters with protocols appropriate to determine $NH_3$-N on ash content, to confirm the anticipated concentrations, and to identify if or which additional mitigative actions discussed below would need to be taken during or to continue the one-unit test phase or with a decision for full four-unit installation (see Section 2.5 Summary of Environmental Commitments). These additional mitigative actions are as follows.

If, or when, monitoring indicates that ammonia on ash concentrations exceed 50 mg/kg leachable $NH_3$-N on ash for the one-unit test (total four-unit average of 12.5 mg/kg for the one-unit test) or an average of 12.5 mg/kg ammonia on ash for a full four-unit installation of SNCR or high-dust technology, TVA would undertake one of the following actions to reduce potential impacts to surface waters and aquatic organisms to insignificance:

- Cease the operation of SNCR or SCR equipment; or
- Control and reduce ammonia slip from the $NO_X$ reduction system to reduce average leachable ammonia nitrogen on ash to less than or equal to 12.5 mg/kg.

Until such time that TVA would:

- Design and reroute discharge from Outfall F-16A through one or two diffuser pipes (see Appendix G for preliminary design) to the Holston River, such that the discharge would not exceed ambient water quality criteria for ammonia, or the appropriate toxicity levels indicated in the earlier discussion of WET limits in Section 3.2 of this EA; or
- Design and implement measures to enhance removal of ammonia compounds in the sediment pond, Wetland JSFW01, and the DSS pond; or
- Design and implement modifications to route a percentage of the storm water runoff to the WSP for treatment along with groundwater leachate (see Section 4.3.3).

Any of the above options would maintain ammonia concentrations at levels that would produce only insignificant impacts to surface water resources or aquatic biota. Additionally, TVA is continuing to explore efficacy and cost effectiveness of other potential mitigation measures such as pumping the DSS pond to the ash pond; pumping the DSS pond to the CCW discharge; installing a pH control system on the DSS pond; installing baffles on the DSS pond to ensure good mixing with the free water volume of the pond; augmenting natural biodegradation of ammonia in the DSS pond; installation of conventional wastewater treatment technology, such as (but not limited to) a trickle filter, ammonia stripping tower, recirculating sand filters, or an activated sludge package plant. If upon further analyses, one or a combination of these technologies becomes feasible and determined to be equally protective of water resources (i.e., maintains discharges so that they meet the ammonia concentration criteria protective of aquatic life criteria that were identified in this EA), TVA will conduct the appropriate level of environmental review prior to implementation.

One additional pathway that does not add to, but would divert ammonia along a different pathway that allows for consideration of additional options for mitigation is as follows. As mentioned earlier, portions (exact extent unknown) of the dry fly ash landfill area are underlain by a groundwater/leachate collection system (DFA Leachate Collection System), which pumps the collected groundwater/leachate (average flow = 0.013 MGD) to the WSP (IMP 008), which then discharges to the bottom ash pond. For the one-unit test installation, the estimated concentration of ammonia nitrogen in groundwater leachate, which would result from operating SNCR or high-dust SCR $NO_X$ reduction technology with 50 mg/kg on the fly ash, would range from 1.7 to 27 mg/L $NH_3$–N. Using the higher number and assuming no removal mechanisms in the WSP, about 2.9 pounds/day of ammonia nitrogen would be added to the bottom ash pond, with a resulting effluent concentration from this source of 0.045 mg/L. This concentration alone would have insignificant impacts on the receiving stream.

Expansion of the DFA Leachate Collection System to prevent additional leachate from reaching the Holston River (see Groundwater Section 4.3), could increase the flow to 0.051 MGD, but the ammonia-nitrogen concentration should remain at 27 mg/L. The expanded DFA Landfill Collection System would add between 11 and 450 pounds per day of $NH_3$-N to the bottom ash pond, with a resulting influent concentration from this source alone of 0.18

to 6.9 mg/L $NH_3$-N. The lower concentration, representative of a one-unit test, would have insignificant impacts on the receiving stream. The higher concentration, representative of four-unit implementation and 500 mg/kg $NH_3$-N on the fly ash would probably require treatment in the WSP or the ash pond, or some other mitigation measure to ensure compliance with anticipated NPDES limits. Since expansion of the DFA Leachate Collection System would be a potential mitigation measure for groundwater issues, it will be discussed in more detail in Section 4.3.2. The design for enhancing the DFA Leachate Collection System, if TVA were to elect this mitigation, would incorporate appropriate treatment for anticipated leachate volumes and $NH_3$-N concentrations collected.

For the proposed one-unit test, the anticipated $NH_3$-N loading to the ash pond from the existing DFA leachate collection system would not be expected to exceed the anticipated target value of 0.29 mg/L of ammonia nitrogen for DSN 001, even if no loss or degradation of $NH_3$-N occurred in the WSP or the ash pond and even if APH wash water metering into the ash pond were allowed to continue following an emergency unit shutdown that resulted in the wet sluicing of fly ash. Therefore, for the proposed one-unit test, $NH_3$-N contaminated water from the existing DFA Leachate collection system would have an insignificant effect on DSN 001, Polly Branch, and the Holston River.

<u>Management of Ammonia Condensate From Ammonia Vapor Supply Lines (Applicable to Alternatives D, E, and F)</u>

The SCR alternatives involving use or potential use of ammonia could generate a small waste stream of condensed ammonia and water vapor. Formation of ammonia-contaminated condensate in ammonia vapor supply lines to the SCRs has occurred at other TVA facilities. Quantities generated were usually relatively small; several months' accumulation could in theory be collected in a 55-gallon drum. TVA would either route the ammonia condensate line to the ash pond either directly or by way of the MCTP; have the collected condensate hauled away by a waste disposal contractor; or have the collected condensate used as fertilizer. Excessive ammonia blowdown line flow may be indicative of other operating problems, such as improper ammonia feed rate, so procedures may need to be modified to ensure appropriate corrective actions are taken if ammonia blowdown line flow increases are noted. Properly mitigated, generation of ammonia blowdown would produce negligible, insignificant impacts to the wastewater treatment systems or on surface waters.

*Summary*

The potential annual loadings of ammonia from the various source pathways into the JSF wastewater treatment system from Alternatives C, E, and F are summarized in Table 4-4. The highest potential loadings of ammonia to the JSF wastewater treatment system would result from chronic groundwater leaching of ammonia-contaminated fly ash, and from intermittent APH wash water. Ammonia-contaminated storm water runoff from the dry fly ash stacking area represents a lesser source, as does wet sluicing of fly ash. Ammonia blowdown represents the least source for causing potential impacts to surface waters.

Alternatives A – No Action or B – Boiler Optimization would not produce any of these loadings. Alternative D–Low-Dust SCR would only have the potential to introduce the minor loadings from ammonia blowdown and the possibility for an ammonia spill (as for any alternative under which ammonia is used). Impacts to surface water from boiler optimization or low-dust SCRs would be insignificant even if installed on all four units at JSF.

If unmitigated and uncontrolled, the potential combined impacts to surface waters from either the test on one unit or full four-unit implementation, which results in discharge of ammonia-nitrogen-containing wastewaters from JSF under Alternatives C, E or F could be significant. Additionally, without mitigation and controls, most of the pathways described have the potential individually to cause violations of existing NPDES permit requirements or failure to meet USEPA Water Quality Criteria protective of aquatic life when the discharges enter the receiving stream. This potential for causing impacts is particularly increased: (1) with increasing $NH_3$-N concentrations on the fly ash; (2) if accumulations of ammonium compounds in the APHs are in the higher end of the possible range; or (3) with the greater loadings associated with installing SNCR or high-dust SCR technology on more than one unit at JSF.

However, with careful adherence to all commitments identified for Alternatives C, E or F, including the monitoring and adaptive operational adjustments (Section 2.5 Summary of Commitments, and as detailed in Appendix A), installation of SNCR or high-dust SCR on one unit or all four units would not have any significant impacts to surface waters.

### *4.2.4 Potential Surface Water Impacts From Nonroutine (Emergency) Situation – Alternatives C, D, E, and F*

SNCR, low-dust SCR, high-dust SCR, and Alternative F, which includes combinations of the different technologies, may all involve use of anhydrous ammonia. A potential pathway for ammonia to be released to surface water would be a failure of an ammonia tank or piping or a spill from an ammonia truck or tank car unloading operation. In order to contain and control an accidental spill of ammonia, the area around the ammonia unloading and storage area would be configured to drain to a spill retention basin. The spill retention basin would be sized to retain the contents of an entire tank, the anticipated water flow from the fogging system, and the rainfall from the 10-year, 24-hour rain event. The spill retention basin at a minimum would be lined with compacted in-situ earth or low permeability clay liner. Following pH testing, spilled material would either be hauled away by a waste disposal contractor, neutralized and recycled to a fertilizer dealer, pumped to an MCTP for treatment or slow release, or slowly released directly to the ash pond at a rate sufficient to maintain compliance with NPDES permit limits. The plant's SWPPP would be revised as necessary to include sampling and pumping after routine rain events.

Alternative C, Install SNCR, includes the option of using a urea solution instead of ammonia for injection into the process. Urea solutions are less hazardous than anhydrous ammonia, but a large urea solution spill could be a significant impact on surface waters, with potential to result in a fish kill from dissolved oxygen depletion. For this reason, secondary containment lined at a minimum with compacted in-situ earth or low permeability clay liner would be designed to hold the contents of the largest urea solution tank and the 10-year, 24-hour rain event. The plant's SWPPP would be revised as necessary to include sampling and pumping after rain events. In the event of a urea solution tank failure, the contents of the secondary containment basin would be recovered for use as fertilizer, hauled away by a waste disposal contractor, or slowly pumped to one of the wastewater treatment ponds (e.g. WSP, MCTPs, or ash pond) at a rate sufficient to maintain compliance with NPDES permit limits.

### *4.2.5 Combined Impacts of Alternatives C, E, and F on Ash Pond*

Without the identified mitigation (Section 2.5), the potential combined impacts to the ash pond from all potential wastewaters containing ammonia after installation of the various

**Table 4-4. Potential Ammonia Loads to Ash Pond From Installation of SNCR or High-Dust SCR $NO_X$ Reduction Equipment at JSF**

| Source of Potential Ammonia | Route | One Unit | | | Four-Unit Low | | | Four-Unit High | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | mg/L | pounds /day | pounds /year | mg/L | pounds /day | pounds /year | mg/L | pounds/ day | pounds /year | |
| APH Wash | -MCTP-ash pond | 0.055 | 3.5 | 1,300 | 0.22 | 14 | 5,100 | 1.1 | 70 | 25,600 | 1 |
| APH Wash 1st flush (75% of ammonia) | -MCTP- treatment or disposal | 0.04 | 2.8 | 950 | 0.17 | 11 | 3,800 | 0.81 | 53 | 19,200 | 1 |
| APH Wash 2nd flush (25% of ammonia) | -MCTP-ash pond | 0.01 | 0.87 | 320 | 0.05 | 3.5 | 1,300 | 0.28 | 18 | 6,400 | 1 |
| Wet Sluicing Fly Ash (23.2 tons, 22 events per year ) | -Ash pond | 0.09 | 1.9 | 42 | 0.09 | 1.9 | 42 | 0.88 | 19 | 420 | 2 |
| DFA Leachate Coll. Sys. | -WSP-ash pond | 0.05 | 2.9 | 1,070 | 0.18 | 12 | 4,300 | 1.84 | 120 | 42,300 | 3 |
| Improved DFA Leachate Coll. Sys. | -WSP-ash pond | 0.18 | 11 | 4,200 | 0.70 | 46 | 16,800 | 6.9 | 450 | 166,000 | 4 |
| Ammonia Blowdown Line | -Drums or MCTP-ash pond | 0.01 | 0.8 | 270 | 0.05 | 3.0 | 1,080 | 0.06 | 3.9 | 1,440 | 5 |
| | | | | | | | | | | | |
| Total $NH_3$-N entering ash pond existing DFA Leachate System and without segregation of APH wash water | | **0.21** | 9.1 | 2682 | **0.54** | 30.9 | 10522 | **3.88** | 212.9 | 69,760 | |
| Total $NH_3$-N entering ash pond improved DFA Leachate System and without segregation of APH wash water | | **0.34** | 17.2 | 5812 | **1.06** | 64.9 | 23022 | **8.94** | 542.9 | 193,460 | |

Notes:

1. Low estimate one-year operation by EPRI (Paul Chu, EPRI, personal communication, December 6, 2004) guidance; high estimate one year at ABB Environmental Systems study method. Each unit has one APH per year, 0.72 MG each.
2. Low: 50 mg/kg on $NH_3$ on fly ash; high 500 mg/kg $NH_3$ (concentrations are based on 8-hour flow of 2.6 MG).
3. Low: 50 mg/kg on $NH_3$ on fly ash; high 500 mg/kg $NH_3$. Dry Fly Ash Leachate Collection System flow at 0.013 MGD.
4. Low: 50 mg/kg on $NH_3$ on fly ash; high 500 mg/kg $NH_3$. Dry Fly Ash Leachate Collection System flow at 0.051 MGD.
5. Estimated as equivalent to 12 drums per year of 15 percent to 20 percent ammonia by weight would be 1,080 to 1,440 pounds.

$NO_X$ reduction technologies under Alternatives C, E, and F could be significant if they result in $NH_3$-N loadings near the mid to higher end of the ranges evaluated. Impacts would be even greater if those loadings resulted from installation on all four units.

Table 4-4 summarizes the combined potential resulting concentrations of $NH_3$-N entering the JSF wastewater treatment system for Alternatives C, E, and F – SNCR, and high-dust SCR. The concentrations are calculated assuming no loss or degradation of $NH_3$-N in the WSP or the MCTPs. The highest potential ammonia loadings to the JSF wastewater treatment system would result from enhancing the DFA Landfill Leachate Collection System to collect groundwater leachate from fly ash contaminated with 500 mg/kg $NH_3$-N.

Another large source of potential ammonia loadings to the wastewater treatment system would be the APH wash water. However, the APH wash water flow could be captured and treated by using the existing MCTP with appropriate modifications. Capture of the APH wash water in the existing MCTP or a pond or tank designed expressly for this purpose and slowly releasing the APH wash water to the JSF ash pond system seems to be the minimum necessary mitigation. As discussed in detail in Appendix A, higher masses of accumulated ammonium compounds in the APH would result in increasingly longer times needed to slowly feed the APH wash water to the ash pond system. If no loss or degradation of $NH_3$-N occurred across the system, higher ammonium compound accumulations in the APHs would result in APH wash water which could not be disposed by slowly feeding to the ash pond in the time available between APH washings without additional treatment. As can be seen in Table 4-4, a one-unit test operated with a limit of soluble $NH_3$-N on the fly ash of 50 mg/kg or less would result in an ash pond concentration of 0.21 mg/L $NH_3$-N when combined with other sources. This concentration is below the USEPA water quality criterion estimated protective concentration for Polly Branch of 0.29 mg/L $NH_3$-N. This concentration could be achieved while continuing slow pumping of APH wash water to the ash pond following an unplanned unit shutdown resulting in wet sluicing. Operation of all four units would require additional means of treatment or mitigation to be in place before groundwater concentrations of $NH_3$-N reached 27 mg/L, since resulting concentrations in the ash pond would exceed 0.29 mg/L $NH_3$-N. Due to the wide range of potential concentrations of $NH_3$-N on the fly ash, monitoring, sampling and evaluation of $NH_3$-N loads across the JSF wastewater treatment system at different operating conditions during the test phase would be essential to design and implement cost-effective mitigation measures to ensure compliance with anticipated NPDES limits.

Because of the wide uncertainty in estimates of ammonia loadings to APH and fly ash, if Alternative C, Install SNCR, were selected, testing that $NO_X$ reduction technology on only one unit and evaluating ammonia compound accumulations in the APH and on fly ash before committing to final design may be an effective wastewater management strategy. However, even for testing and evaluation on one unit, mitigation measures such as a carbon dioxide addition system for pH control on DSN 001, and restoring the capability to capture APH wash water in the MCTP or similar facility and slowly release it to the ash pond would need to be in place to ensure ammonia compound contaminated wastewater does not adversely impact Polly Branch and the Holston River. Even with mitigation measures in place, initial operation of SNCR or high-dust SCR at JSF should be limited to ammonia slip that results in no more than 50 mg/kg of soluble $NH_3$-N on the fly ash.

If SNCR were selected, the sampling plan contained in Appendix C should be implemented to collect appropriate background information as soon as feasible. If the ammonia content on the fly ash or in any of the wastewater streams reaches the trigger points, ammonia or urea additions would be turned down or off. The ammonia slip rates, loadings on fly ash, and resulting concentrations in the JSF wastewater treatment system would be measured long enough to analyze any potential impacts from adding additional $NO_X$ reduction technologies to additional units before those systems are designed, specified, or purchased. In addition, those measurements would be utilized to select and design the most cost-effective mitigation measures/operational strategies to ensure that there are no significant environmental impacts from implementation of $NO_X$ reduction technologies at JSF. While the $NO_X$ reduction systems are operating, monitoring data would be collected, evaluated, and reported until sufficient data are available to assist in the design of possible future $NO_X$ reduction systems.

## 4.3 Groundwater Resources

### *4.3.1 Construction Impacts*

Alternative A - No Action and Action Alternative B – Boiler Optimization

There would be no groundwater resource impacts associated with either of these alternatives.

Alternative C – Install SNCR on Units 1 Through 4

Construction activities potentially affecting groundwater resources would be limited to excavations associated with SNCR process structures, equipment, and subsurface pipelines. Excavations would not exceed about 5 feet in depth, and would not be expected to encounter groundwater. Groundwater control, if needed, would be limited to short-term dewatering from excavations. The overall impact of construction of an SNCR system on groundwater resources would be negligible.

Alternatives D through G – Install Low-Dust SCR, High-Dust SCR, or Combinations of Alternatives Sequentially on Units 1 Through 4

Construction impacts of these alternatives on groundwater would be similar to Alternative C.

### *4.3.2 Operational Impacts*

Alternative A - No Action or Alternative B - Optimize Boilers on Units 1 Through 4

There would be no groundwater resource impacts beyond the current local impact to shallow groundwater quality beneath the ash disposal and coal storage areas.

Alternative C - Install SNCR on Units 1 Through 4

Operation of SNCR technology would result in some slip of ammonia past the reaction in the flue gases, and therefore creation of ammonia-contaminated ash that would be collected in the dry fly ash stacking area. A portion of this ammonia is likely to leach from rainwater (enter a soluble state and travel with water) from the dry fly ash stack, entering groundwater below the stack, as well as storm water runoff from the stack (see Wastewater Section for discussion of this surface water issue).

Using numerical simulation models TVA evaluated: (1) the predicted amount and concentration of ammonia-contaminated leachate, (2) predicted pathways, (3) potential for impacts to groundwater, and (4) the likely connection to, as well as potential effects on, surface water resources (Appendix D). Based upon a number of factors discussed in Appendix D, without actual operational data, there is a wide range of possible leachable concentrations of $NH_3$ accumulating on the fly ash from SNCR operation and, therefore, some uncertainty as to the characteristics of the resulting leachate in groundwater and that reentering surface waters of the Holston River from groundwater. TVA's present analysis has bounded the range of potential impacts and established a step-wise decision process for implementing the appropriate level of measures to implement for protection of groundwater and surface water resources.

The most likely scenario for potential impacts for Alternative C is as follows. Groundwater flow patterns in the areas of the dry stack indicate that the ammonia-contaminated leachate dispersing with the ambient groundwater system would be transported about 500 feet north by shallow groundwater to the Holston River. No impacts to existing or future groundwater users in the site vicinity would occur since all property downgradient of the ash stack lies within the plant reservation.

Modeling results indicate that, with an anticipated $NH_3$-N content of 12.5 mg/kg on fly ash (corresponding to one unit operating either SNCR or high-dust SCR with 50 mg/kg $NH_3$-N accumulating on the fly ash and no ammonia deposition from the other three units), a one-year test would eventually result in an estimated aqueous $NH_3$-N concentration of about 7.6 mg/L in groundwater leachate entering the Holston River with an estimated $NH_3$-N loading of 0.78 kg/day to the river. Under these conditions, leachate seepage would eventually occur along approximately 1,250 feet of river frontage opposite the stack. A plume, varying in maximum width of 10 to 20 feet, would extend off the shoreline along up to 1,255 feet of the 3,500 feet of TVA-owned plant property before the $NH_3$-N concentration of the plume would drop below 0.41 mg/L $NH_3$-N, the concentration level estimated by the USEPA 1999 Water Quality Criteria for ammonia as protective of aquatic organisms for extreme high temperature conditions encountered at Holston River in proximity to JSF. This means that the plume would dissipate approximately one-third of the way between the north end of the dry fly ash landfill and the confluence of Polly Branch and the Holston River. This estimated ammonia-nitrogen load (Appendix D, Table D-1) to the Holston River is well within the assimilative capacity of the river, and the computer modeling results indicate that the localized toxicity to aquatic organisms would be insignificant since the plume of concentrations higher than the applicable water quality criteria protective of aquatic life, 0.41 mg/L $NH_3$-N (Section 3.2.2, Table 3-5), would only cover a small area in the immediate vicinity of the plant and would only affect the surface layer of water, not the mid and lower depths. Based upon the modeling for a one-unit, one-year operational SNCR test at JSF, such a demonstration would not be expected to produce significant adverse environmental impacts. Assuming a plant average concentration of 12.5 mg/kg ammonia nitrogen on fly ash for one-unit operation is confirmed, in order to avoid or mitigate potential surface water impacts to insignificance, TVA would need to implement one or more of the mitigations identified in Section 4.3.3 and the Summary of Commitments for full four-unit implementation of SNCR technology at JSF.

However, due to the aforementioned uncertainty in the characteristics of the leachate entering the river and use of models, TVA is proposing an adaptive management approach to decision-making for decisions regarding continuation of the demonstration or full four-unit implementation of this alternative. TVA is proposing a one-year test/demonstration of SNCR technology on one unit at JSF to gather both operational performance and environmental data, which upon review in finding of acceptable environmental results at the one-year mark, may extend the test to a second year. TVA's present assessment has bounded the potential for impacts for the test and full four-unit implementation; identified a clearly defined process; conditions for implementation of mitigations; and clearly identified avoidance or mitigative actions TVA would undertake under the specified conditions. The information gained during the test period would be used by TVA in selection of $NO_X$ reduction technology and determination for the need for which, if any, mitigation need be implemented at JSF for either continuing the testing phase or full four-unit implementation of SNCR or high-dust SCR technology (or combinations). Near the end of and/or immediately following the one-year test, TVA would evaluate the data and information collected per the sampling and monitoring plan of Commitment 14 of the Summary of Commitments. The evaluation of environmental data would determine and result in:

- Refined knowledge of the actual amounts of ammonium compounds accumulating on fly ash.

- Revised numerical modeling results incorporating actual operational data of ammonium compound accumulations on fly ash to refine estimates of ammonia-nitrogen leachate concentrations, which may result from single-unit operation for more than one year or for full implementation on all four units.

- Data to indicate whether the test should be stopped immediately, and the described mitigation measures put in place or the one-unit installation may continue operating without such mitigation.

- A basis for, if necessary, realigning sampling and monitoring until adequate process knowledge is obtained to confirm operational impacts are insignificant..

- A preliminary indication of the likelihood for whether data during the monitoring period would indicate a need to stop or severely scale back the SNCR or High Dust SCR operation and implement the identified mitigation measures of Commitments 14, 15, and 18 before continuing.

- A basis for determining whether the full four-unit installation can proceed unmitigated (but per the monitoring plan), or that TVA would need to immediately proceed with selecting among and implementing mitigation measures identified in Commitment 18.

At the end of this test period, based upon the performance outcome and determination of need for mitigation, TVA may decide to continue testing or to implement one of the alternatives identified in this EA.

The reasons for TVA proceeding along this adaptive path are: (1) robust monitoring and timely evaluation of information gained; (2) a step-wise approach with the ability and commitment to curtail or stop actions and/or implement mitigations prior to significant impacts occurring or accruing; (3) current analyses that “bound” the range for TVA actions and resulting potential environmental impacts; (4) defined trigger levels for actions to avoid or mitigate environmental impacts; and (5) identified, clearly defined and effective mitigations, which TVA has committed to implement should the agency decide to proceed under conditions that, without mitigation, could, as potentially indicated by comparison of monitoring data and standards, criteria, and USEPA guidelines for WET limits, result in significant environmental impacts. Either a confirmation of current analyses of most likely levels of leachate concentration or, if needed, implementation of these measures would limit leachate from the dry fly ash stack to causing only insignificant impacts to both groundwater and the consequent impacts to surface waters of the Holston River.

There would be no potential for contamination of off-site water supply wells due to ammoniated ash leachate seepage from the dry stack. Groundwater flow patterns in the stack vicinity suggest that ammonia-affected leachate entering the groundwater system below the base of the dry ash stack would be transported about 500 feet north by shallow groundwater to the Holston River. All leachate seepage would discharge into the river through the riverbed along approximately 1,250 feet of river frontage opposite the dry stack. No impacts to existing or future groundwater users in the site vicinity would occur since all property downgradient of the ash stack lies within the plant reservation. Furthermore, there would be no opportunity for development of large production wells in the vicinity of the plant reservation that could alter existing groundwater gradients and induce off-site movement of contaminated groundwater. Bedrock in the site vicinity is comprised of the Sevier Shale which is not an aquifer, and is capable of supporting only small domestic water-supply wells.

Alternative D - Low-Dust SCR on Units 1 Through 4

Ash produced by the low-dust SCR process would contain no residual ammonia and would be similar in composition to the ash currently generated by JSF. Therefore, the groundwater impacts of disposing of low-dust SCR ash in the proposed dry stacking facility would, like Alternative A, have no significant groundwater impacts.

Alternative E - High-Dust SCR on Units 1 Through 4

Ash produced by the high-dust SCR process would be expected to contain ammonia compounds similar to ash produced by the SNCR processes. Consequently, potential groundwater impacts associated with this alternative would be similar to Alternative C. Since a high-dust SCR may operate at extremely low ammonia slip rates when the catalysts are new, Alternative E may be less likely to result in ammonia compounds in groundwater exceeding action levels.

Alternative F - Combinations of Alternatives B Through E

Groundwater impacts associated with any combinations involving Alternative C or E would be similar to those impacts described for Alternative C. The combination of Alternatives B and D would like Alternative A have no significant groundwater impacts.

### *4.3.3 Groundwater Mitigation Measures for Alternatives C, E, or F*

Alternative mitigation measures that would avoid or reduce the level of impacts from ammonia compounds in groundwater leachate follow. These measures could be used alone or in combination as necessary to protect groundwater and surface water resources.

Interim Cap and Underdrain System for Capture of Ammonia Contaminated Leachate

Under the present ash management plan for JSF, the ammonia-contaminated fly ash would be added to the top of the existing fly ash landfill at JSF. A system utilizing a low permeability interim cap or landfill liner and an underdrain system could be designed and built to capture and divert ammonia-contaminated leachate from the top of the dry fly ash stack to the wastewater treatment systems at JSF. Such a system could prevent ammonia-contaminated leachate from reaching the groundwater. Since the interim cap or liner would only cover the top 63 acres of the dry fly ash stack, the volume of ammonia-contaminated leachate would be less than if the leachate were allowed to migrate farther down the dry fly ash stack before being collected for treatment. Table 4-5 shows the anticipated volume of contaminated groundwater leachate that might be collected from an interim cap and underdrain system and the range of potential ammonia-nitrogen concentrations that might be expected given a range of 12.5 to 500 mg/kg ammonia on the fly ash. Possible wastewater treatment measures for this leachate have been described in Section 4.2. Under the action plan incorporated in the preliminary design for a one-unit SNCR test, a variation on this mitigation measure whereby the interim cap is installed on top of approximately 10 acres of ammonia-compound-contaminated fly ash might be selected. Since installation of a cap and drain system over a lesser area would result in less loading to the JSF wastewater treatment systems, the impact of this variation on the plant wastewater treatment systems would also be insignificant.

Improve Existing Leachate Collection System and Wastewater Treatment Systems to Capture and Treat all Ammonia-Contaminated Groundwater Leachate

As discussed in Chapter 3, the existing leachate collection system was not designed to capture leachate flowing into the river, but rather to intercept effluent from two existing tile drains, which prior to this installation, discharged directly to the river. Borehole flow meter testing has shown most groundwater flow occurs close to the top of the rock (approximately elevation 1,058). Depending on results of evaluation of subsurface conditions and project economics, either a series of French drains or horizontal wells could be designed and installed between the foot of the dry fly ash landfill and the river. This system would capture groundwater flow, which would then be pumped to the plant's wastewater treatment system. Engineering design would have to account for dike stability concerns, since the dry fly ash landfill is located on top of a former ash pond. The design would also have to account for the anticipated efficiency of the enhanced leachate collection system and incorporate additional mitigation measures in the event that the projected collection efficiency was not adequate to divert enough of the contaminated leachate away from the Holston River. The second line in Table 4-5 gives the range of flows and estimated ammonia-nitrogen concentrations in ash leachate, which could potentially be added to the JSF wastewater treatment system if this mitigation option were chosen.

Reduce Leachable $NH_3$ Compounds in Fly Ash to Acceptable Levels

This could be accomplished by fly ash beneficiation to remove ammonia from the fly ash, which will be described in Section 4.5. For Alternative E, High-Dust SCR, or Alternative F (if it were a combination of Alternatives B and E), decreasing leachable $NH_3$ compounds in fly ash could be accomplished by operating high-dust SCRs as described below.

Operate High-Dust SCR at Low Ammonia Slip

This mitigation measure would only apply to Alternative E, High-Dust SCR, or Alternative F if it were a combination of Alternatives B and E. TVA and other industry operating experience indicates that high-dust SCRs can be operated at low ammonia slip especially when the catalysts are new. Lack of excess ammonia to deposit on the fly ash could eliminate the problem of ammonia-contaminated groundwater leachate for the first few years of operation, allowing completion of other possible mitigation measures to be deferred until the time the ammonia slip rates might be expected to increase due to catalyst age.

**Table 4-5. Estimated Volumes and Ammonia Nitrogen Concentration Ranges for Groundwater Mitigation Options for Alternatives C, E, or F**

| Groundwater Mitigation Option | Potential Volume of Contaminated Groundwater Leachate Requiring Treatment | | Range of Estimated $NH_3$-N Concentrations in Groundwater Leachate | |
|---|---|---|---|---|
| | Drought Cubic Feet per Day | Average Cubic Feet Day | Ash $NH_3$ = 12.5 mg/kg mg/L $NH_3$-N | Ash $NH_3$ = 500 mg/kg mg/L $NH_3$-N |
| Install interim cap (or liner) with underdrain leachate collection system | 3230 | 3840 | 31 | 1250 |
| Improve existing leachate collection system | 5450 | 6810 | 27 | 1068 |
| Reduce leachable $NH_3$ compounds in fly ash to acceptable levels | 0 | 0 | ≤27 mg/L $NH_3$-N (1) | |

(1) Engineering study will determine $NH_3$-N concentrations in groundwater flux to Holston River, which will not adversely impact water quality.

## 4.4 Floodplains and Flood Risk

### *4.4.1 Alternative A – No Action and Alternative B – Boiler Optimization*

Under Alternative A, No Action, and Alternative B, Boiler Optimization, there would be no impacts to the 100-year floodplain in this area.

### *4.4.2 Alternatives C, D, E, and F*

Construction of the remaining alternative systems for $NO_X$ emission reduction (Alternatives C through F) would not involve construction within the 100-year floodplain, and all components of the system, including any ammonia storage tanks, would be located outside the 500-year floodplain. Therefore, this portion of the project would comply with EO 11988. Under Alternatives C through F, some road and railroad construction and/or modifications could be required. This work would not involve construction within the 100-year floodplain. For Alternatives C, E, and F, an underground pipeline and outfall would be constructed within the 100-year floodplain. Minor alterations to existing outfalls for storm water detention ponds may also be necessary for Alternatives C, D, E, and F. For compliance with EO 11988, an underground pipeline and outfall and alterations to other outfall piping would be considered to be repetitive actions in the floodplain that would not result in adverse floodplain impacts because the area would be returned to pre-construction conditions after completion of the project. However, to ensure compliance with EO 11988, if mitigation measures involving construction of a diffuser or other alterations to outfalls were selected, TVA would not store any materials subject to flood damage within the 100-year floodplain.

## 4.5 Coal Combustion Byproduct Generation, Marketing, and Handling

### *4.5.1 Alternative A – No Action*

For the No Action Alternative, fly ash and bottom ash marketing and handling would be expected to continue as under present conditions with no anticipated impacts.

### *4.5.2 Alternative B – Boiler Optimization*

Alternative B, Boiler Optimization for $NO_X$ Removal, could cause the unburned carbon to increase in the fly ash. Unburned carbon is also detrimental to fly ash marketing. Levels above 4 percent unburned carbon (measured as LOI) in fly ash would not be marketable. If current fly ash marketing projections of 60,000-100,000 tons per year can be maintained, the life of the dry fly ash stacking area would be extended from its original five-year planned life to at least seven years, or through 2011. If marketing cannot be maintained at these levels, the capacity of the dry fly ash stacking area would be exhausted by about 2009. The existing area would have to be closed and a new dry fly ash stacking area would need to be permitted and developed at least three years prior to that time. That action would undergo environmental review at the appropriate time.

### *4.5.3 Alternatives C and E – SNCR and High-Dust SCR, and F - Combinations of Alternatives B through E*

As described earlier, considerable variation in the range of ammonia compound accumulations on the fly ash could occur during operations of SNCR or high-dust SCR, depending on the ammonia slip rates, the type of coal burned, operating conditions, site-specific equipment configuration, and the particle sizes of the fly ash (EPRI, 1998; 2004). For the purposes of analyses in this EA, ammonia compound accumulations on fly ash were assumed to vary between 50 and 500 mg/kg for the ash generated from one unit. If only one unit were operating $NO_X$ emissions reduction equipment, the lowest average ammonia concentration on the fly ash might be assumed to be 12.5 mg/kg, which would result from the ash of three units operating without ammonia depositions on the fly ash (i.e., not running $NO_X$ reduction equipment with any ammonia slip) being mixed with that of one unit operating at 50 mg/kg ammonia on the fly ash. Operation in this manner might be expected to occur during the one-unit test phase of Alternative C or F. The maximum concentration of 500 mg/kg ammonia on the fly ash was carried through the analyses for the purpose of estimating the potential maximum environmental impacts. Therefore, Alternatives C, E, and F, could impact fly ash marketing to a greater or lesser extent, depending on the ammonia concentration in the ash.

During operation of SNCR (Alternatives C or F), some amount of constant ammonia slip would be expected. This would be expected to result in ammonia deposition on the fly ash. During operation of high-dust SCR (Alternative E), ammonia slip would be expected to increase as the catalyst ages. Most of the anticipated ammonia slip is expected to be adsorbed on the fly ash in the form of ammonium bisulfate, which tends to be a “sticky” compound. Some of this contaminated ash would adhere to the APHs where it would be removed periodically by washing with water. Most of the rest of the ammoniated ash would be removed in the ESPs and collected dry in hoppers for pneumatic transport to the dry fly ash silo. For a discussion of the potential impacts and mitigation measures for handling ammoniated ash, see 4.2 Surface Water and 4.3 Groundwater.

If the dry fly ash collection system is bypassed, ammoniated fly ash would be sluiced to the bottom ash pond where the ammonia would dissolve into the sluice water. The concentration of the ammonia in the sluice water would depend upon the amount of fly ash sluiced, the concentration of ammonia on the fly ash, and the volume of water in the pond.

If concentrations of ammonia exceed 100 mg/kg ammonia in the dry fly ash, JSF fly ash marketing would be adversely impacted. Variability of ammonia concentrations in the fly ash can be as detrimental to marketing as high levels—for example, if the concentration fluctuates from 50 mg/kg one week to higher or lower levels the following week and is generally inconsistent, customers may be reluctant to commit to using this source.

If current fly ash marketing projections of 60,000-100,000 tons per year can be maintained, the life of the dry fly ash stacking area would be extended from its original five-year planned life to at least six years, or through 2011. If marketing cannot be maintained at these levels, the capacity of the dry fly ash stacking area would be exhausted by about 2009. The existing area would have to be closed and a new dry fly ash stacking area would need to be permitted and developed at least three years prior to that time. That action would undergo environmental review at the appropriate time.

### *4.5.4 Alternative D – Low-Dust SCR*

Action Alternative D would not result in ammonia deposition on the fly ash. If current fly ash marketing projections of 60,000-100,000 tons per year can be maintained, the life of the dry fly ash stacking area would be extended from its original five-year planned life to at least six years, or through 2011.

### *4.5.5 Possible Impacts on Bottom Ash Handling*

Installation of any of the action alternatives for $NO_X$ emissions reduction at JSF would not be expected to impact bottom ash use since the bottom ash is collected in the boiler prior to ammonia injection. However, if ammoniated fly ash is sluiced to the bottom ash pond, odor problems could impact workers at the bottom ash processing plant. As discussed in Sections 4.1 and 4.2, the anticipated ammonia concentrations in the ash pond that would result from startup and shutdown fly ash sluicing would not evolve sufficient quantities of ammonia to exceed applicable OSHA ammonia exposure thresholds. Therefore, anticipated effects of installation of the action alternatives on bottom ash handling would be insignificant.

### *4.5.6 Use and Impacts From Fly Ash Beneficiation as Potential Mitigation of High LOI and Ammonia-Contaminated Fly Ash*

Due to the favorable economics of recycling fly ash into concrete, numerous processes have been invented to reduce unburned carbon (LOI) concentrations in fly ash to marketable levels. With the increased deployment of $NO_X$ emissions reduction systems, many of these processes have been adapted to also remove ammonia from the fly ash.

The fly ash beneficiation processes for enhancing fly ash marketability by removing or passivating excess unburned carbon and ammonia fall into three main categories: thermal, physical separation, and chemical processes. Thermal fly ash beneficiation processes involve increasing the temperature. Examples of this would be reburning the fly ash by injection into a specialized small boiler designed to reduce LOI or recycling a side stream of the fly ash into one of the main boilers. Temperatures involved in reburning fly ash for LOI reduction cause the ammonia compounds to either revolatilize or decompose. Resultant ammonia concentrations on fly ash of ≤5 mg/kg have been reported. If the LOI concentrations are not high enough to support self-sustained combustion, propane or natural gas could be used as a supply supplemental fuel supply. This EA will assume the propane supply system proposed for the low-dust SCR (Alternative D) processes will be adequate also to supply propane, if needed, for fly ash beneficiation by reburning, or other potential thermal fly ash beneficiation measures. If needed propane supplies exceed those described in Chapter 2 of this EA or if natural gas is selected for a secondary fuel source, additional environmental review will be undertaken at that time. Thermal stripping of ammonia from fly ash by heating the fly ash in various types of reactors has also been extensively described in the literature. Suggested reactors and processes for thermally stripping ammonia without the benefit of combustion range from heated fluidized beds to recycling air heated by waste heat over the hoppers to facilitate ammonia off-gassing. Physical separation processes involve both dry mechanical separation equipment like vibrating screens or centrifuges or wet separation processes, which function due to relative buoyancy differences of different size particles. Unburned fly ash carbon usually has less than 1/100th the available surface area of activated carbon, but some chemical fly ash beneficiation processes involve addition of a substance that decreases the available adsorptive capacity of the unburned carbon in the fly ash to "passivate" it. Other chemical beneficiation processes involve additives either to make the ammonia compounds less soluble or to remove the ammonia compounds from the ash. Since most of the thermal fly ash beneficiation processes and the dry mechanical separation processes would not involve any appreciable change in equipment, air emissions, or wastewater streams from those already present or anticipated with installations of $NO_X$ reduction systems at JSF, these types of fly ash beneficiation measures have already been covered by this EA, and their impacts would be insignificant. However, if fly ash beneficiation is chosen as a mitigation measure for reducing LOI or removing ammonia from fly ash, the appropriate environmental review would be conducted at that time, to confirm that details of the proposed installation have been subject to adequate review. Installation and operation of a proven fly ash beneficiation technology, which reduces leachable ammonia compounds to appropriate levels, would make the potential groundwater impacts of ammonia compound deposition on fly ash insignificant.

## 4.6 Terrestrial Ecology

### *4.6.1 Environmental Consequences to Terrestrial Plants*

<u>Alternative A - No Action Alternative</u>

Under the No Action Alternative, no $NO_X$ reduction equipment would be installed at JSF, and the project area would likely remain in its current state. No impacts to uncommon terrestrial communities or otherwise unusual vegetation would be expected as a result of this alternative.

<u>Alternative B - Boiler Optimization</u>

Under the boiler optimization alternative, $NO_X$ monitors, temperature monitors, computer control systems, and other equipment would be installed, interconnected, and programmed to reduce $NO_X$ formation in the boilers at JSF. These installations would take place inside or immediately outside the powerhouse, so no disturbance of existing plant communities would occur during the boiler optimization process. No impacts to uncommon terrestrial communities or otherwise unusual vegetation would be expected except the possible beneficial impact of reduced $NO_X$ emissions.

<u>Alternatives C, D, E, and F</u>

Some disturbance of existing plant communities would occur during installation of the new $NO_X$ emissions reduction equipment. Since no uncommon terrestrial communities or otherwise unusual vegetation occurs on the lands to be disturbed under these proposed action alternatives, impacts to the terrestrial ecology of the region are expected to be insignificant as a result of these proposed action alternatives.

### *4.6.2 Environmental Consequences to Terrestrial Animals*

<u>Alternative A - No Action Alternative</u>

Under the No Action Alternative, no $NO_X$ emissions reduction equipment would be installed at the JSF, and the project area would likely remain in its current state. Therefore, terrestrial animals and their habitats would not be affected.

<u>Alternative B - Optimize Boilers for Units 1 Through 4 at the John Sevier Fossil Plant</u>

Under Alternative B, all equipment installation would be restricted to the existing powerhouse and would not result in the disturbance of habitat within the proposed project area. No impacts except the possible beneficial impacts of reduced $NO_X$ emissions would occur. Therefore, terrestrial animals and their habitats would not be affected.

<u>Alternative C - Installation of SNCR on Units 1 Through 4</u>

Under Alternative C, SNCR emission-reduction system would be installed on one unit for testing as early as the fall of 2006 and would be installed on the remaining units at JSF following successful testing.

The majority of the proposed project area consists of previously and heavily disturbed habitats, resulting in a large proportion of nonvegetated and mowed grass areas that are essentially unsuitable to terrestrial animals. The remaining habitat has been previously disturbed, remains in early successional stages, and is heavily fragmented. The installation of the SNCR systems at one to four units would displace a portion of the early successional grass/forb, scrub-shrub, or immature forest habitats, and any associated terrestrial animals. Little disturbance of terrestrial animal populations is expected given the already heavily disturbed and fragmented nature of the existing habitats, as well as the similarity of surrounding habitat that would remain. These alternatives would not result in adverse impacts to caves or heron colonies in the vicinity. Therefore, Alternatives C and D would displace or disrupt very little wildlife, and impacts to terrestrial animals and their habitats would still not be significant.

<u>Alternative D - Installation of Low-Dust SCR on Units 1 Through 4; Alternative E - Installation of High-Dust SCR on Units 1 Through 4; and Alternative F - Combinations of Alternatives</u>

Under Alternatives D and E, two low-dust SCRs would be installed or four high-dust SCRs would be installed at JSF following successful testing of the SNCR system under Alternative C or could be installed without installation of the SNCR system if tests are unsuccessful. Alternative F involves combinations of technological options, which could include installation of one of the SCR technologies at some point.

Alternatives D and E would disturb more ground than Alternative C. However, since this ground has already been heavily disturbed, this would displace a similar amount of habitat in the same location as Alternative C. Therefore, these alternatives would similarly have no significant impacts on terrestrial animal species, their habitats, or other unique terrestrial habitats. Depending on the combination of alternatives selected, Alternative F could displace habitat necessary for the installation of any of the $NO_X$ reduction options on one to four units. No impacts for alternatives B through E are significant for terrestrial animals and their habitats within the proposed project area, and any combination of these alternatives would similarly have no significant impact.

## 4.7 Aquatic Ecology

Installation and operation of the proposed $NO_X$ emissions reduction systems could potentially impact aquatic communities in the Holston River. However, appropriate mitigation measures such as those described in Section 2.5 and Section 4.2 would make these potential impacts insignificant.

### *4.7.1 Alternative A – No Action*

Under the No Action Alternative, no $NO_X$ emissions reduction equipment would be installed or operated, so no impacts to aquatic life would result.

### *4.7.2 Alternative B – Boiler Optimization*

Under Alternative B, Boiler Optimization, all equipment installation would be restricted to the existing powerhouse, so no impacts to aquatic life would result, except possible beneficial impacts of reduced $NO_X$ emissions.

### *4.7.3 Alternatives C, D, E, and F Construction Impacts*

Under Alternatives C, D, E, and F, potential construction impacts to Holston River would include temporary erosion and siltation resulting from construction of the following: $NO_X$ reduction systems in the vicinity of the powerhouse, ammonia or urea storage tanks, construction of propane storage tanks (for Alternatives D and F only), possible construction of warehouses, laydown areas, railroad tracks, construction of spill retention basins, and for alternatives C, E, and F, construction of the proposed diffuser system for the DSS pond. These areas have previously been disturbed by plant construction and modification activities. These impacts would be minimized by implementation of BMPs to control erosion during construction and stabilize disturbed areas as soon as practicable after disturbance (Muncy, 1999). TVA BMPs for erosion control include recommended plant species for revegetating and stabilizing disturbed areas and guidelines for using native plant species. Native plant species require less long term maintenance and should be used when feasible. As described in section 4.2, surface runoff would be routed to existing treatment facilities that meet regulatory requirements. These measures would substantially reduce the potential impacts in Holston River to the point of causing only minor, temporary, and insignificant effects on fish and other aquatic life.

### *4.7.4 Alternatives C, E, and F Operational Impacts*

The storage, handling, and use of anhydrous ammonia (or aqueous ammonia or urea solutions) for the proposed SNCR system (Alternative C) or the proposed high-dust SCR system (Alternative E) or combinations of action alternatives (Alternative F) would result in the potential for the release of ammonia or other nitrogenous compounds to surface water and impacts to aquatic life. One pathway for impacts is a direct accidental release of ammonia to surface water. The engineered features of the anhydrous ammonia system include a retention basin for spills and emergency water fogging to minimize this risk. Another pathway for surface water impacts is ammonia contamination of combustion byproducts such as fly ash. As discussed in Section 4.2, any ammonia accumulations on fly ash sluiced to the ash pond during plant startups and shutdowns or on ash accumulating in the APHs would be expected to dissolve and increase ammonia concentrations in the ash pond. Similarly, storm water runoff from 10-acre active ash handling area on the dry ash stack would be expected to dissolve ammonia compounds from contaminated ash and carry this ammonia-contaminated water to the discharge of the dry stack-stilling pond. In addition, precipitation would be expected to eventually seep through the dry ash stack and result in small quantities of ammonia being released to the Holston River by groundwater seepage. Another pathway for ammonia release to surface water would be condensate in the ammonia vaporization system. This condensate (also known as ammonia line blowdown) would be routed to one of the chemical treatment ponds and then slowly released to the ash pond to reduce the risk of impacting aquatic life,, directly released to the ash pond depending on the flow and concentration estimated in final design, or collected for disposal offsite or use as fertilizer. Management of water treatment system flows and other appropriate mitigation measures as necessary (see Section 2.5) would maintain discharge ammonia concentrations at levels that would safeguard water quality and protect aquatic life. Appropriate mitigation of ammonia concentrations in effluent water would result in insignificant impacts to aquatic life that uses adjacent areas of Cherokee Reservoir for spawning or feeding.

### *4.7.5 Alternative D – Low-Dust SCR Operational Impacts*

The storage, handling, and use of anhydrous ammonia for the proposed low-dust SCR system (Alternative D) would result in the potential for ammonia contamination of surface water and impacts to aquatic life. Table 2-3 documents two pathways for ammonia releases to surface water. The first pathway would be the direct accidental release of ammonia to surface water. The engineered features of the anhydrous ammonia system include a retention basin for spills and emergency water fogging to minimize this risk. Another pathway for surface water impacts would be ammonia and water condensate in the ammonia blowdown line from the boiler. The condensate from the ammonia system blowdown line would be routed to one of the MCTPs and then slowly released to the ash pond to reduce the risk of impacting aquatic life. The potential for ammonia impacts to surface water or aquatic lifeforms from either of these pathways is very low compared to Alternatives C, E, and F. Management of water treatment system flows and other appropriate mitigation measures as necessary (see Section 2.5) would maintain discharge ammonia concentrations at levels that would safeguard water quality and protect aquatic life. Appropriate mitigation of ammonia concentrations in effluent water would result in insignificant impacts to aquatic life that uses adjacent areas of Cherokee Reservoir for spawning or feeding.

## 4.8 Threatened and Endangered Species

### *4.8.1 Environmental Consequences to Threatened or Endangered and Rare Terrestrial Plants*

No Action Alternative (Alternative A)

No occurrences of the state-listed or federally listed plant species are known on or immediately adjacent to JSF; no impacts to such plant species are expected as a result of the No Action Alternative.

Action Alternatives B, C, D, E, and F

No occurrence of the state-listed or federally listed plant species is known on or immediately adjacent to the lands to be disturbed under any of the proposed action alternatives; no impacts to such plant species are expected.

### *4.8.2 Environmental Consequences to Threatened or Endangered and Rare Terrestrial Animal Species*

Alternative A - No Action Alternative

Under the No Action Alternative, no $NO_X$ emissions reduction equipment would be installed at the JSF, and the project area would likely remain in its current state. Therefore, this alternative would not result in adverse impacts to federally listed or state-listed protected terrestrial animal species or their habitats.

Alternative B - Optimize Boilers for Units 1 Through 4 at the John Sevier Fossil Plant

Under Alternative B, all equipment installation would be within the existing powerhouse and not require disturbance of habitat within the proposed project area. No impacts except the possible beneficial impacts of reduced $NO_X$ emissions would occur. Therefore, protected terrestrial animal species and their habitats would not be affected.

Alternative C: Installation of SNCR on Units 1 Through 4 at the John Sevier Fossil Plant

Under Alternative C, the SNCR emission reduction system would be installed on one unit for testing as early as the fall of 2006 and would be installed on the remaining units at JSF following successful testing of the SNCR system.

Suitable habitat for common ravens, Allegheny woodrats, woodland jumping mice, and hairy-tailed moles does not exist within the project area. Therefore, these species would not be affected by the proposed project.

Although not part of the proposed project area, the adjacent Holston River may provide foraging habitat for the three federally listed species, i.e., bald eagles, gray bats, and Indiana bats. No other habitat requirements for any of these species exist within the proposed project area, and any displacement of habitat within the project area should not affect the Holston River as potential foraging habitat for these species and, therefore, result in no effects to federally listed species.

Little habitat exists for Rafinesque's big-eared bat and the barn owl within the proposed project area. No evidence of either species was found in the project area. Therefore, this action alternative is not expected to impact either species.

Habitat for southeastern shrew, common shrew, and southern bog lemming exists in the early successional vegetation surrounding the ditches and man-made ponds within the proposed project area. These species likely occur in suitable habitat within the project area. There would be temporary disturbance to these species during construction of the $NO_X$ emissions reduction equipment, but adverse impacts are not expected due to their mobility, wide range of habitat preferences, and abundance of suitable habitat in the surrounding area.

Alternative D - Installation of Low-Dust SCR on Units 1 Through 4; Alternative E - Installation of High-Dust SCR on Units 1 Through 4; and Alternative F - Combinations of Alternatives

Under Alternatives D and E, two low-dust SCRs would be installed or four high-dust SCRs would be installed at JSF. Alternative F involves combinations of technological options, since installation of one of the SCR technologies could be done after one-unit SNCR testing or after full implementation of SNCR.

Alternatives D and E would disturb more ground, but due to the highly disturbed nature of the site, these alternatives would displace a similar amount of habitat as Alternative C. Therefore, these Alternatives would similarly have no significant impacts on any federally listed or state-listed terrestrial animal species and their habitats. Depending on the combination of alternatives selected, Alternative F could displace habitat necessary for the installation of any of the $NO_X$ emissions reduction options on one to four units. No impacts for Alternatives B through F are significant for protected terrestrial animal species and their habitats within the proposed project area, and any combination of these alternatives would similarly have no significant impact.

### *4.8.3 Environmental Consequences to Threatened and Endangered Aquatic Animal Species*

No Action Alternative

Under the No Action Alternative, $NO_X$ emissions reduction equipment would not be installed or operated, so no impacts to state-listed or federally listed aquatic animal populations would result.

Action Alternative B - Boiler Optimization

Under Action Alternative A, Boiler Optimization, only monitoring and computer control equipment would be installed within the immediate vicinity of the existing powerhouse, so no impacts to state-listed or federally listed aquatic animal populations would result.

Action Alternatives C, E, and F

Construction Impacts—Because no state-listed or federally listed aquatic animals are known to occur in the section of the Holston River impounded by Cherokee Dam, or the John Sevier Detention Dam, no impacts to protected aquatic animals would result from construction activities under any of these action alternatives.

Operational Impacts—The storage, handling, and use of anhydrous ammonia for the proposed $NO_X$ emissions reduction systems would result in the potential for ammonia contamination of surface water and impacts to aquatic life. One pathway for impacts is a direct accidental release of ammonia to surface water. The engineered features of the ammonia system would include a retention basin for spills and emergency water fogging to minimize this risk. Another pathway for surface water impacts is ammonia contamination of combustion byproducts including bottom ash and fly ash. Water discharged from the on-site ash pond may contain ammonia. Management of water treatment system flows and other appropriate mitigation measures as necessary (see Sections 2.5 and 4.2) would maintain discharge ammonia concentrations at levels that would safeguard water quality and protect aquatic life. Appropriate mitigation of ammonia concentrations in effluent water would ensure that no significant impacts to water quality occur in Cherokee Reservoir or the John Sevier Detention Reservoir.

Since no state-listed or federally listed species are known or likely to occur in areas that could be directly impacted by water discharges, no impacts to state-listed or federally listed species would be anticipated to occur as a result of operational activities under any of these action alternatives.

Action Alternative D

Construction Impacts—Construction impacts would be similar to those described for Alternatives C, E, and F.

Operational Impacts—The storage, handling, and use of anhydrous ammonia for the proposed $NO_X$ emissions reduction systems would result in the potential for ammonia contamination of surface water and impacts to aquatic life. Similar to Alternatives C, E, and F, these potential impacts to aquatic communities from storage, handling, and use of anhydrous ammonia would be mitigated with a retention basin for spills and an emergency water fogging system.

Alternative D would differ from the other action alternatives because installation and operation of a low-dust SCR system on Units 1 through 4 would not be anticipated to result in the accumulation of ammonia compounds in the fly ash. Therefore, the potential for impacts to aquatic resources in the Holston River would be even less than for Action Alternatives C, E, and F. Further, there would be no potential for impacts to state-listed or federally listed species as a result of operational activities under this alternative.

## 4.9 Managed Areas

### *4.9.1 Alternative A – No Action*

Under Alternative A, no $NO_X$ reduction equipment would be installed at the JSF. Therefore, no impacts would occur to the one ecologically significant site that is within 3 miles of the proposed project. Because no managed areas or NRI streams are in the vicinity of the proposed project, no impacts to such areas and streams would occur.

### *4.9.2 Alternatives B Through F*

Under any of the proposed action alternatives, no significant impacts to natural areas are anticipated because the distance from the Beech Creek Unit 7 PDCH is sufficient (2.1 miles) and because this ecologically significant site is upstream and upwind from JSF. No managed areas or NRI streams are in the vicinity of the proposed project; therefore, no impacts would occur to such areas and streams as a result of project activities as defined under these alternatives.

## 4.10 Wetlands

Potential wetland impacts resulting from the proposed action include the conversion of wetlands, erosion and sedimentation in wetlands, soil compaction, hydrologic alteration, and reduction of certain functions such as providing wildlife habitat. For the proposed actions, the majority of these potential impacts would be avoided or minimized through wetland avoidance and implementation of BMPs (Muncy, 1999). As described below, with implementation of these measures, impacts to wetlands would be insignificant.

### *4.10.1 Alternative A – No Action; and Alternative B – Optimize Boilers for Units 1 Through 4 at JSF*

Under the No Action Alternative and the Boiler Optimization Alternative, Wetland JSFW01 would continue to receive runoff from the Dry Ash Stacking area and Wetland JSFW02 would receive runoff from the eastern end of the plant. Both wetlands would filter sediment and potential pollutants from storm water runoff.

### *4.10.2 Alternative C – Install SNCR on One to Four Units at JSF; Alternative E – High-Dust SCR on One to Four Units at JSF; Alternative F – Combination of Alternatives B Through E*

Alternatives C, E, and F would not have any direct adverse effects on any wetlands at the site. During high-precipitation storm events, storm water runoff from the ash pile into Wetland JSFW01 would be expected to contain $NH_3$ concentrations of approximately 27 mg/L $NH_3$-N or less, based on the assumption that ammonia accumulations on the fly ash would be 350 mg/kg or less. If the assumption about ammonia accumulations on fly ash are incorrect, and ammonia concentrations on the fly ash actually approach 500 mg/kg, ammonia concentrations in storm water runoff entering Wetland JSFW01 could potentially approach 39 mg/L $NH_3$-N in response to rainfall events. Based on available literature many wetlands have been shown to assimilate and/or remove $NH_3$ concentrations as high as 55 mg/L $NH_3$ (Hilton, 1993; Hunter et al., 1993; Green and Upton, 1993). Since $NH_3$ removal is strongly correlated with bacterial action, removal efficiency is higher during the spring, summer, and fall and lowest in winter. In another study Hill et al. (1997) demonstrated that $NH_3$ concentrations as high as 82.4 mg/L did not have any significant effect on biomass production of several wetland plants. $NH_3$ in storm water runoff would not have any adverse impacts on Wetland JSFW01.

Soil disturbance during construction of the anhydrous ammonia and propane storage facilities could potentially lead to indirect adverse impacts on Wetland JSFW02 by increasing sediment mobilization in storm water runoff during the construction period. Utilization of BMPs and other engineering controls (Muncy, 1999) would minimize the opportunity for sediment to leave the construction site without affecting wetlands.

### *4.10.3 Alternative D – Install Low-Dust SCR on Units 1 Through 4 at JSF*

Under Alternative D, no ammonia accumulation on the fly ash would occur, so the water quality of the storm water runoff from the dry fly ash stack would not change from present operating conditions. Construction impacts to Wetland JSFW02 during construction of the anhydrous ammonia and propane storage facilities would be similar to those described for Alternative C.

## 4.11 Transportation

No Action Alternative

If no plans are undertaken to add $NO_X$ emissions reduction equipment at JSF, none of the roads listed in Table 3-11 In Section 3.11 would be affected.

Action Alternatives B, C, D, E, and F

By building $NO_X$ emissions reduction equipment at JSF, there would be minor impacts to the federal, state, and county roads during both the construction and operational periods. The construction period and workforce would vary according to the options as shown in the following table.

**Table 4-6. Anticipated Peak Employment and Duration for Action Alternatives**

| Alternative | Peak Workforce | Peak Duration | Construction Period |
|---|---|---|---|
| Alternative A | 140 | N/A | N/A |
| Alternative B | 155 | 3 weeks | 4 months |
| Alternative C<br>- 1 Unit<br>- Full | <br>100<br>150 | <br>3 months<br>3 months | <br>10 months<br>2 years |
| Alternative D | 500 | 6 weeks | 2 years |
| Alternative E | 600 | 6 weeks | 2 years |
| Alternative F | 600 | 6 weeks | 2 years |

N/A = not applicable

There would also be additional traffic added to the road network throughout the day in the form of construction material deliveries to the site (estimated at 100 deliveries per day). These deliveries may be by highway or rail. Assuming an average ridership of 1.6 persons per vehicle, and a trip in and out each day, up to 750 vehicle trips would be added to the road network due to daily commuters during this period. Some additional delay may be experienced at the local intersections at shift changes, primarily at TN 70 and TN 66. Such a problem can be easily tolerated for the short-term duration of the construction period. The employment levels would spike to peak levels in short durations, rising and falling quickly over a period of a few months. A much smaller number of additional workers may be on site performing construction-related work during the few months before and after a unit outage.

The methodology in the *Highway Capacity Manual*, (Transportation Research Board, 1994) was used to identify possible traffic flow problem areas. The manual provides a qualitative method to measure the operational conditions within a traffic stream and their perception by motorists. This method takes into account lane widths, shoulder effects, average highway speed, alignment, etc. Six levels of service (LOS) are defined and given letter designations, from A to F, with LOS A representing the best conditions and LOS F the worst. The upper limit of LOS E is considered to be the capacity of the facility. At several representative points, the LOS provided to the existing traffic was compared to the LOS to the sum of the existing traffic and the projected additional traffic. The results are shown in Table 4-7.

**Table 4-7. Existing and Anticipated Levels of Service on Roadway Segments in the Vicinity of Proposed Project**

| Roadway segment | Existing Level of Service (LOS) | Anticipated LOS |
|---|---|---|
| TN 66 (South of TN 70) | D | D |
| TN 66 (North of TN 70) | E | E |
| TN 70 | C | C |
| Old Highway 70 | D | D |

For all alternatives, the roads in this area are fully capable of absorbing this additional traffic with no drop in the existing LOS currently provided to the road users. In the long term, operation of $NO_X$ reduction would not generate any noticeable additional traffic for the roads in the local area. The potential traffic impact for both the construction and operational phase of the $NO_X$ reduction facility is insignificant.

Ammonia and Propane Unloading Facilities/Operations–Continual deliveries of ammonia, propane, and urea may be required for utilizing the various $NO_X$ reduction options. The unloading facility would be sited southeast of the plant and northwest of the unloaded railroad yard. After construction is completed, operation would require a minimal additional permanent staff. Delivery of these products is anticipated to be via rail. As noted in Table 4-8, the delivery volumes and frequencies would vary by option.

**Table 4-8. Rail Car Deliveries per Week**

| Alternative | Ammonia | Propane | Urea |
|---|---|---|---|
| Alternative A | None | None | None |
| Alternative B | None | None | None |
| Alternative C | 0 to 4 | 0 | 0 to 6 |
| Alternative D | 2 | 7 | None |
| Alternative E | 2 | None | None |
| Alternative F | 0 to 4 | 0 to 7 | 0 to 6 |

A short rail spur and turnout would be constructed from the existing plant track to either unloading facility location. JSF plans to conduct the unloading operations of these products utilizing on-site locomotives and personnel. None of the options would affect the capacity of the railroad mainline.

Since the no net reductions in LOS for local roads and highways would result from the action alternatives for construction of $NO_X$ emissions reduction equipment at JSF and deliveries of ammonia, propane, or urea for operating $NO_X$ emissions reduction equipment under the various action alternatives would not affect the railroad mainline, impacts to transportation from all of the proposed alternatives would be insignificant.

## 4.12 Socioeconomics and Environmental Justice

### *4.12.1 Construction Impacts for Alternative A – No Action and Alternative B – Boiler Optimization*

There would be no differential impacts under the No Action Alternative. Alternative B would have virtually no impacts given additional staffing of only 15 people for three weeks.

### *4.12.2 Construction Impacts for Alternative C – Install SNCR on One to Four Units*

Employment

For installation of SNCR technology, Alternative C has two phases. Design and construction would last approximately 10 months for the first phase. There would be a three-month overlap of Phases 1 and 2. Peak staffing for Phase 1 is estimated at 100 people. Phase 2 would require approximately 12-15 months with a short duration peak of 150 people. These peak-staffing levels would occur intermittently during about three months of each phase. Related construction activities would be minimal.

Income

Total cost of labor is expected to be a few million dollars, which would be less than 1 percent of the annual earnings in Hawkins County. However, since some workers would commute from surrounding counties, especially Sullivan County, the impact on Hawkins County income would be even less than this. The impact on the entire labor market area would be less than one-tenth of 1 percent. An additional small and temporary impact on earnings would result from construction-related purchases and spending by workers.

Population

Given the population of the labor market area (over 500,000 people), the majority of the workforce likely would be drawn from the local area, resulting in minimal changes in population, and any increase in population would be of short duration. Additionally, workers who move to the area for only temporary work are less likely to bring their families with them. Any incoming workers would locate to areas within the labor market area where housing is most readily available.

Community Services and Infrastructure

The impact on community services, such as police, fire, medical, and education would be small because of the small impact on population and the short duration of the maximum impact.

#### *4.12.3 Construction Impacts for Alternative D – Install Low-Dust SCR on Units 1 Through 4*

Employment

Alternative D would require increased staffing for approximately 20 months, reaching a short duration peak of about 500 workers. Except for the peak periods, which would occur off and on over about three months, staffing would be in the 100-175 range. Related construction activities would be minimal.

Income

Total cost of labor is expected to be a few million dollars, which would be less than 1 percent of the annual earnings in Hawkins County. However, since some workers would commute from surrounding counties, especially Sullivan County, the impact on Hawkins County income would be even less than this. The impact on the entire labor market area would be less than one-tenth of 1 percent. An additional small and temporary impact on earnings would result from construction-related purchases and spending by workers.

Population

Given the population of the labor market area (over 500,000 people), the majority of the workforce likely would be drawn from the local area, resulting in minimal changes in population, and any increase in population would be of short duration. Additionally, workers who move to the area for only temporary work are less likely to bring their families with them. Any incoming workers would locate to areas within the labor market area where housing is most readily available.

Community Services and Infrastructure

The impact on community services, such as police, fire, medical, and education would be small because of the small impact on population and the short duration of the maximum impact.

#### *4.12.4 Construction Impacts for Alternative E – Install High-Dust SCR on Units 1 Through 4*

Employment

Alternative E would require increased staffing for approximately 20 months, reaching a short duration peak of about 600 workers. Except for the peak periods, which would occur off and on over about three months, staffing would be in the 100-200 range. Related construction activities would be minimal.

Income

Total cost of labor is expected to be a few million dollars, which would be less than 1 percent of the annual earnings in Hawkins County. However, since some workers would commute from surrounding counties, especially Sullivan County, the impact on Hawkins County income would be even less than this. The impact on the entire labor market area would be less than one-tenth of 1 percent. An additional small and temporary impact on earnings would result from construction-related purchases and spending by workers.

<u>Population</u>

Given the population of the labor market area (over 500,000 people), the majority of the work force likely would be drawn from the local area, resulting in minimal changes in population, and any increase in population would be of short duration. Additionally, workers who move to the area for only temporary work are less likely to bring their families with them. Any incoming workers would locate to areas within the labor market area where housing is most readily available.

<u>Community Services and Infrastructure</u>

The impact on community services, such as police, fire, medical, and education would be small because of the small impact on population and the short duration of the maximum impact.

### *4.12.5 Construction Impacts for Alternative F - Combinations of Alternatives B Through E*

<u>Employment</u>

Alternative F would require increased staffing for approximately 30 months. The first 10 months would see a peak of approximately 400 workers, followed by a peak of 600 workers during the final 20 months. Except for the peak periods, which would occur off and on over about three months, staffing would be in the 100-150 range during the first 10 months and 100-200 during the last 20 months. Related construction activities would be minimal.

<u>Income</u>

Total cost of labor is expected to be more than the other alternatives by a few million dollars, but still no more than 1 percent of the annual earnings in Hawkins County. However, since some workers would commute from surrounding counties, especially Sullivan County, the impact on Hawkins County income would be less than this. The impact on the entire labor market area would be less than a few tenths of 1 percent. An additional small and temporary impact on earnings would result from construction-related purchase, and spending by workers.

<u>Population</u>

Given the population of the labor market area (over 500,000 people), the majority of the workforce likely would be drawn from the local area, resulting in minimal changes in population, and any increase in population would be of short duration. Additionally, workers who move to the area for only temporary work are less likely to bring their families with them. Any incoming workers would locate to areas within the labor market area where housing is most readily available.

<u>Community Services and Infrastructure</u>

The impact on community services, such as police, fire, medical, and education would be small because of the small impact on population and the short duration of the maximum impact.

### *4.12.6 Operational Impacts on Socioeconomics for All Alternatives*

Once construction is complete, any operational changes would be minor under any of the action alternatives and would have no noticeable socioeconomic impacts. Under the No Action Alternative, there would be no impacts on operations.

### *4.12.7 Environmental Justice*

The proposed actions would physically be a minor addition to an expansive heavy industrial facility that has a significant property buffer area. Therefore, during construction, important impacts are unlikely on any residents of the surrounding area, and disproportionate impacts on minority or low-income populations are unlikely. On the other hand, all residents in the surrounding area, including minority and low-income residents, would benefit from the reduction in $NO_X$.

In general, operational impacts would be minor and not noticeable to residents of the surrounding area. However, there is a small chance of ammonia releases, as discussed earlier. In the unlikely event of such releases, demographic data indicate that disproportionate impacts on minority populations would be unlikely. As can be seen in Table 4-9, the minority population percentage within the block group (1.9 percent) and within the census tract (2.0 percent) where the JSF is located is less than Hawkins County as a whole (3.3 percent), and far less than the state (20.8 percent). However, there is the possibility of slightly disproportionate impacts on low-income individuals, given that the low-income population percentage in the block group (17.6 percent) and the census tract (16.9 percent) is slightly greater than Hawkins County (15.8 percent) and the state (13.5 percent).

**Table 4-9. Population Statistics for Proposed Project Area**

| Geography | Total Population 2000 | Minority Population 2000 | Low-income Population 1999 |
|---|---|---|---|
| Block Group 1 | 1355 | 1.9 % | 17.6 % |
| Census Tract 508 | 4522 | 2.0 % | 16.9 % |
| Hawkins County | 53,563 | 3.3 % | 15.8 % |
| Tennessee | 5,689,283 | 20.8 % | 13.5 % |

Source: U.S. Bureau of the Census, 2000 Census of Population

## 4.13 Visual Resources

Consequences of the impacts to visual resources are examined based on changes between the existing landscape and the landscape character after alteration, identifying changes in the landscape character based on commonly held perceptions of landscape beauty and the aesthetic sense of place. Collectively, the introduction of $NO_X$ reduction equipment and related construction activity, as proposed, would not result in significant impacts to the existing visual resources.

### *4.13.1 Alternative A – No Action*

Under the no action alternative, steps would not be taken to remove $NO_X$ from coal combustion flue gases at JSF. The scenic attractiveness and scenic integrity would remain as they exist.

### *4.13.2 Alternative B – Optimize Boilers for Units 1 Through 4 at JSF*

Under Alternative B, monitors, computer control systems, and other equipment would be installed within the powerhouse area, or in the immediate vicinity. Proposed project elements in this alternative would not be readily discernable from viewing positions previously described in Section 3.13. This alternative, as proposed, would not impact the existing scenic value of the project area.

#### *4.13.3 Alternative C – Install SNCR on One to Four Units at JSF*

Under Alternative C, installation of several project elements would occur within the plant or boiler and would not be readily visible. The introduction of these aboveground features would not result in a discernable contrast from the existing landscape character. The installation of storage facilities for ammonia and/or propane would potentially require modifications to the existing rail service in the immediate vicinity. These modifications to existing rail service would not permanently affect the landscape character of the plant site. Diffuser pipes and pipe headers could be required for mitigation of wastewater impacts. Impacts associated with installation of the diffuser pipes would remain in context with construction activities, which would generate temporary visual, insignificant discord. In addition to these alternative-specific elements, views of the general construction-related elements would be seen in broader context with existing plant structures and operations and would not significantly impact existing visual resources.

#### *4.13.4 Alternative D – Install Low-Dust SCR on Units 1 Through 4 at JSF*

Under Alternative D, TVA would install low-dust SCRs on Units 1 through 4, which would require duct and equipment structures not included in the previous alternatives. The low-dust SCR alternative would include the installation of ammonia tanks and propane tanks. Rail service near proposed ammonia tanks or propane tanks would potentially be modified to facilitate installation and operation of these project elements. Components of Alternative D would be similar in scale and character to existing plant structures and operations and would not significantly impact existing visual resources.

#### *4.13.5 Alternative E – Install High-Dust SCR on Units 1 Through 4 at JSF*

Under Alternative E, installation of roughly twice as much ductwork would occur than under Alternative D. Similarities to the previous alternatives include potential diffuser pipes, ammonia tanks, construction parking, laydown and staging areas, and the possibility of a modification to the rail delivery system near ammonia tanks on Figure 2-3. This proposed alternative would remain in context with the existing landscape character and would not result in a significant impact to existing visual resources.

#### *4.13.6 Alternative F – Combinations of Alternatives B Through E*

Under Alternative F, combinations of the previously discussed alternatives would be combined to address the removal of $NO_X$ from the coal combustion flue gases at TVA's JSF. The combination of these project elements would remain similar in context to the established industrial landscape character. Recreational river users, shoreline, and near-shore residents would have views of the reduction equipment, construction parking, laydown, and staging areas amidst structures and operations that are similar in scale and visual character, causing them to be seen as subordinate elements in the landscape. Motorists traveling McDonald Hills Road would have similar views, but those views available would be intermittent through existing vegetation and of considerably shorter duration.

Residents and motorists in the vicinity would likely notice a slight increase in traffic within the project area. This incremental increase would not result in an overly adverse impact to existing visual resources. Views also available to motorists and nearby residents would include project elements noted in previous descriptions and descriptions of their individual impacts. Alternative F, as with each of the previous alternatives, would be compatible with the established landscape character.

## 4.14 Recreation

### *4.14.1 Alternative A – No Action*

Under the No Action Alternative, no new recreation facilities or opportunities would be provided, so no new risks would be introduced to the plant site and the surrounding communities. However, no benefits to public health that may result from improvements to local and regional air quality would be achieved.

### *4.14.2 Alternatives B, C, D, E, and F*

Under all other alternatives, there would be some degree of impacts to recreation, particularly fishing from the bank, at the inlet and discharge channel. These impacts would be associated with restrictions to parking during the construction phase. Even if TVA imposed no formal restrictions on parking during construction, there would still be fewer parking spaces. There would still be walking access to the discharge channel from the campground, although, this would be a considerable walk. These impacts should be considered temporary in nature. Normal boating access to these sites would be expected to continue as usual except for possibly a brief period of restriction for installation of the proposed diffuser on the DSS pond discharge, if TVA selects that mitigation option. None of the preliminary conceptual designs for any of the action alternatives indicate a need to close the campground during construction.

From available preliminary conceptual design information, no reasons for restricting or eliminating existing public parking after construction are readily apparent. Similarly, the proposed facility locations for the various action alternatives would not reduce the amount of land used for public pedestrian access areas and most frequented by bank fishermen. Therefore, under normal operating conditions, there would be no impact to recreation. However, under the most critical events and to some degree less critical events, as discussed in Sections 4.1.5 and 4.1.6, there would be impacts to recreation. The degree of these impacts would be as hypothetical as the event but these impacts would also be considered temporary. In summary, if no new restrictions on public parking or pedestrian access occur, there would be no impacts on recreation.

## 4.15 Cultural Resources

Six different alternatives have been considered for the proposed project including the No Action Alternative, boiler optimization, installation of SNCR systems, installation of low-dust SCR systems, installation of high-dust SCR, and a final action alternative, which includes combinations of the other action alternatives. As discussed in Section 3.15, the APE for the archaeological resources that could be potentially affected by this project was defined as the 271 acres in which land-disturbing activities could occur. For historic structures, the APE was determined as those areas from which the alterations would be visible within a 0.5-mile radius. A records search at the Tennessee Historical Commission and the Tennessee Division of Archaeology indicated no previously recorded or National Register of Historic Places (NRHP) listed properties are located within the project's APE. A review of the archaeological APE, by TVA's Cultural Resources Staff, found that previous ground-disturbing activities associated with the construction and operation of JSF would have removed any remnants of the archaeological record assuming such remains had been in place. Specifically, there are no historic sites or structures located within the APE, and the 1952-1957 construction activities associated with the startup and operation of JSF have been extensive, such that any archaeological resources that may have been present would have been obliterated by these construction and operational activities. In regard to potential effects to historic structures, based on the low profile of the storage tanks and the presence of JSF and based on the fact that the supporting infrastructure has compromised the historic viewshed of the surrounding region, it is TVA's finding that the proposed project would not adversely or visually affect any historic properties that are listed on or are eligible for listing on the NRHP (Karpynec, 2004).

Pursuant to Section 106 of the National Historic Preservation Act and its implementing regulations at 36 CFR Part 800, TVA in consultation with the Tennessee State Historic Preservation Officer (SHPO) determined that the proposed undertaking would not affect any archaeological sites, historic sites, or historic structures that are listed on or are eligible for listing on the NRHP. The formal concurrence of the SHPO is documented in the letter in Appendix E.

## 4.16 Seismology

As discussed in Section 3.16, there is a minimal likelihood for earthquake in the JSF area. Although there is only minor potential for occurrence, the earthquake hazard to ordinary buildings at the proposed project site would be addressed through adherence to the seismic provisions of the Uniform Building Code (ICBO, 1997) or more recent building codes as appropriate. The earthquake hazard at the JSF relative to other locations in the United States is low (Zone 1 on a scale of 0 to 4 with 4 being the highest hazard) based on the 1997 Uniform Building Code (ICBO, 1997). Special structures that house hazardous processes or sensitive equipment may require additional considerations. Transportation of hazardous substances (e.g., ammonia) through underground or aboveground piping may also require special designs and careful siting to address seismic hazards. Adherence with the seismic provisions of the Uniform Building Code (ICBO, 1997) is standard practice for TVA, so this would apply for all of the alternatives. Compliance with appropriate construction codes would make potential environmental impacts due to the effect of seismic activity on the ammonia storage system insignificant.

## 4.17 Tornado Risk

As previously discussed, with the calculated occurrence interval for how often, on average, a tornado may affect a particular site (i.e., 2,857 years for JSF), the risk of damage to proposed project equipment from tornados is negligible. However, the risk of damage from tornados or high winds to structures or equipment at the proposed project site would be addressed through adherence to the wind load design provisions of the Uniform Building Code (ICBO 1997) or more recent building codes as appropriate. Special structures that house hazardous processes or sensitive equipment may require additional considerations. Transportation of hazardous substances (e.g., ammonia) through aboveground piping may also require special designs and careful siting to address meteorological hazards. Adherence with the wind load design provisions of the Uniform Building Code (ICBO, 1997) is standard practice for TVA, so this would apply for all of the alternatives.

## 4.18 Cumulative Impacts

### *4.18.1 Cumulative Impact to Air Quality From Action Alternatives*

Introduction—TVA's Proposed $NO_X$ Control Strategy

TVA has installed, is in the process of installing, or is considering the installation of additional $NO_X$ controls, using SCR or SNCR technologies, at up to nine other coal-fired power plants (Allen, Bull Run, Colbert, Cumberland, Johnsonville, Kingston, Paradise, Shawnee, and Widows Creek). Table 4-10 lists all units being considered including the proposed action at JSF. This strategy, which goes beyond current regulatory requirements, would reduce TVA coal-fired power plant $NO_X$ emissions by 79,000 metric tons (87,000 tons) during the ozone season (May to September) beginning in 2006. When combined with other controls already planned to meet the acid rain requirements under the Clean Air Act Title IV, the total $NO_X$ reduction during the 2006 ozone season will be 171,000 metric tons (189,000 tons). To meet Title IV requirements, low-$NO_X$ burners have already been installed on 34 TVA boilers; staged over-fire air has been installed on six units; and combustion optimization has been installed on an additional 18 units. The controls would reduce TVA's seasonal $NO_X$ emissions roughly 75 percent below 1990 levels.

Because the $NO_X$ reduction installations listed in Table 4-10 would satisfy most if not all of TVA's requirements, there are currently no plans to install further $NO_X$ reduction systems at other units at Widows Creek Units 1-6, and Gallatin Fossil Plants. $NO_X$ reduction from these units would be more costly and produce less significant environmental benefit than the units identified in Table 4-10.

The new controls would help reduce local and regional ozone levels, and would help prevent violations of the new more stringent 8-hour ozone standard that was promulgated by USEPA in 1997. The strategy is also consistent with the types of controls that would be needed to comply with USEPA's proposed rule for ozone transport, known as the ozone transport State Implementation Plan call.

**Table 4-10. TVA Fossil Plant Units Planned for Installation of SCR Systems or Other $NO_X$ Reduction Technologies**

| Unit | State | Generation Capacity (Megawatt) | Year Installed or Estimated to be Completed |
|---|---|---|---|
| Paradise 2 | Kentucky | 704 | 2000 |
| Paradise 1 | Kentucky | 704 | 2001 |
| Paradise 3 | Kentucky | 1,050 | 2003 |
| Allen 2 | Tennessee | 330 | 2002 |
| Allen 3 | Tennessee | 330 | 2002 |
| Allen 1 | Tennessee | 330 | 2003 |
| Widows Creek 7 | Alabama | 575 | 2003 |
| Widows Creek 8 | Alabama | 550 | 2004 |
| Cumberland 2 | Tennessee | 1,300 | 2004 |
| Cumberland 1 | Tennessee | 1,300 | 2003 |
| Bull Run | Tennessee | 950 | 2003 |
| Kingston 1-4, 7-8 | Tennessee | 1,300 | 2004 |

| Table 4-10. TVA Fossil Plant Units Planned for Installation of SCR Systems or Other $NO_X$ Reduction Technologies | | | |
|---|---|---|---|
| **Unit** | **State** | **Generation Capacity (Megawatt)** | **Year Installed or Estimated to be Completed** |
| Kingston 5-6 | Tennessee | 400 | 2005 |
| Kingston 9 | Tennessee | 200 | 2006 |
| Colbert 5 | Alabama | 500 | 2004 |
| Colbert 1-4 | Alabama | 800 | 2005 to 2014 |
| Johnsonville 1 | Tennessee | | 2005 |
| Shawnee | Kentucky | | 2005 |
| John Sevier 1-4 | Tennessee | 800 | 2006 to 2016 |

$NO_X$ emitted into the atmosphere leads to the formation of ozone and fine particulate and contributes to increased acidity of precipitation. Thus, the cumulative impact on air quality (due to a reduction in $NO_X$ emissions) would be beneficial.

Ozone Reduction

Precise quantification of ozone changes due to the proposed action is not practical or possible due to daily variations in meteorology and operating conditions. It is possible, however, to assess the overall impact of the proposed action in combination with anticipated $NO_X$ reductions at other TVA fossil plants. This assessment is possible by comparing the results of photochemical modeling performed with and without consideration of TVA's overall $NO_X$ reduction strategy. Specifically, modeling was performed as part of the effort of the Ozone Transport Assessment Group's (OTAG) work that considered the $NO_X$ and VOC emissions in the eastern half of the United States projected to the year 2007. Photochemical modeling was performed with the OTAG emissions databases modified to reflect the effect of TVA's $NO_X$ strategy. Although modeling was limited to a single 10-day episode in 1995, the results are illustrative of the effect of TVA's $NO_X$ reduction strategy on atmospheric ozone. Within Alabama, Kentucky, and Tennessee, the modeling indicated that TVA's $NO_X$ reduction strategy would decrease the overall peak 1-hour ozone in the ambient atmosphere by 2, 4, and 4 percent, respectively, and the peak 8-hour ozone burden would be decreased by 2, 3, and 4 percent, respectively. This modeling did not include the additional $NO_X$ emission reductions that would occur at JSF, since the modeling was performed prior to consideration of installing $NO_X$ reduction equipment at JSF. It is reasonable to assume that reduction of $NO_X$ emission from JSF would further aid in reducing ozone. In addition, it is important to note that the modeling did not account for additional $NO_X$ emission reductions that are likely to occur from other utilities as a consequence of recent USEPA action establishing statewide $NO_X$ budgets in the eastern states.

### *4.18.2 Cumulative Impacts of Alternatives C, E, and F on Surface Water and Groundwater*

Without the identified mitigation (Section 2.5), the potential cumulative impacts to surface waters from all potential wastewaters containing ammonia after installation of the various $NO_X$ reduction technologies under Alternatives C, E, and F could be significant if they result in loadings predicted by the higher ABB Environmental Systems values at higher slips. Impacts would be even greater if those loadings resulted from installation on all four units.

Additionally, without mitigation, many of the pathways have the potential to individually cause violations of NPDES permit requirements and cause toxicity to aquatic life in the Holston River or Polly Branch.

However, by careful adherence to all commitments identified for Alternatives C, E, or F, including recommended monitoring and operational adjustments, installation of SNCR or high-dust SCR should not have any significant impacts on surface water or groundwater.

Table 4-4 summarizes the potential annual ammonia loadings to JSF wastewater treatment systems from Alternatives C, E, and F – SNCR and High-Dust SCR. Alternative B – Boiler Optimization would not produce any of these potential ammonia loadings. Alternative E – Low-Dust SCR would only have the potential wastewater loads from the ammonia blowdown line and the possibility of an ammonia spill. Impacts from Low-Dust SCR should be insignificant, even if installed on all four units.

The highest potential ammonia loadings to the JSF wastewater treatment system would result from groundwater leaching of fly ash contaminated with 500 mg/kg $NH_3$. As previously discussed, computer modeling predicts the groundwater flux from an ammonia load equivalent to that of only one unit operating at 50 mg/kg ammonia deposition on the fly ash, which would be one-fourth of the 15,290 pounds shown in Table 4-4. If a mitigation measure designed to be 100 percent effective in removing ammonia from the fly ash or at diverting the ammonia-contaminated groundwater leachate from fly ash contaminated with 500 mg/kg ammonia failed and was only 97.5 percent effective, the potential significant adverse impact could still occur. With a limit of 100 mg/kg ammonia on the fly ash, leachate collection or fly ash beneficiation would only need to be 95 percent effective to avoid the potential adverse impact.

Another large source of potential ammonia loadings to the wastewater treatment system would be the APH wash water. However, the APH wash water flow could be captured and treated by using the existing MCTP with appropriate modifications. Modifications to the MCTP for treating APH wash water would provide the plant with the operational flexibility to treat a large ammonia spill if necessary. Enhancement of the wastewater treatment system's capabilities to treat ammonia-laden wastewater would also aid in the treatment of groundwater leachate from the dry fly ash if either the interim cap or underdrain system were installed. Groundwater leachate from the dry fly ash stack could potentially be treated in the WSP prior to release to the ash pond.

Ammonia-contaminated storm water runoff from the dry fly ash stack represents one of the smaller potential loadings and could be mitigated by installation of a diffuser system on Storm Water Outfall F-16A or by rerouting part of the flow to the WSP. These two mitigation measures could also be used in combination to optimize treatment and cost effectiveness.

The ammonia nitrogen contaminated wet-sluiced fly ash would be very difficult to capture and treat. Therefore, the easiest method of mitigating potential impacts from wet-sluiced fly ash would be to limit soluble ammonia on fly ash concentration to <100 mg/kg or to add pH controls on the ash pond effluent to reduce potential toxicity. Without mitigation, the potential cumulative impacts from all potential wastewaters containing ammonia after installation of SNCR or high-dust SCR could be significant if they result in loadings predicted by the higher ABB Environmental Systems values at higher slips. Impacts would be even greater if those loadings resulted from installation on all four units.

Because of the wide uncertainty in estimates of ammonia loadings to APH and fly ash, if Alternative C - SNCR were selected, testing that $NO_X$ reduction technology on only one unit and evaluating ammonia compound accumulations in the APH and on fly ash before committing to final design may be an effective wastewater management strategy. However, even for testing and evaluation on one unit, mitigation measures would need to be in place to ensure ammonia compound contaminated groundwater leachate or storm water runoff from the dry fly ash landfill does not adversely impact the Holston River. Even with mitigation measures in place, initial operation of SNCR at JSF should be limited to ammonia slip that results in no more than 50 mg/kg of ammonia on the fly ash.

If SNCR were selected, the sampling plan contained in Appendix C should be implemented to collect appropriate background information as soon as feasible. If the ammonia content on the fly ash or in any of the wastewater streams reaches the trigger points, ammonia or urea additions should be turned down or off. The ammonia slip rates, loadings on fly ash, and resulting concentrations in the JSF wastewater treatment system should be measured long enough to analyze any potential impacts from adding additional $NO_X$ reduction technologies to additional units before those systems are designed, specified, or purchased. In addition, those measurements should be utilized to select and design the most cost-effective mitigation measures/operational strategies to ensure that there are no significant environmental impacts from implementation of $NO_X$ reduction technologies at JSF. While the $NO_X$ reduction systems are operating, adequate monitoring data should be collected, evaluated, and reported until sufficient data are available to assist in the design of possible future $NO_X$ reduction systems.